Department of **Transportation**
Monroe County, New York

Maggie Brooks
County Executive

Terrence J. Rice, P.E.
Director

MEMORANDUM

TO: Distribution

FROM: James R. Pond, P.E., PTOE, Associate Traffic Engineer

DATE: December 24, 2008

RE: **Guidelines for Conducting Traffic Engineering Studies**

The subject document was first distributed in November 1994. Its intent is to outline MCDOT policies and procedures in conducting various traffic engineering studies and surveys. This is an update of the 1994 document. It is to be used as a guide in determining the appropriateness of various traffic control devices, what traffic data to collect to make such determinations and the devices use should it be justified. If a traffic control device is not specifically covered in the guidelines, it means there is no specific MCDOT policy or procedure covering its use. However, its use would be covered in the Manual of Uniform Traffic Control Devices (MUTCD) or the NYSDOT's Supplement to the MUTCD. MCDOT's policies and procedures would conform to the Manual(s).

In September 2007, New York State switched from the state MUTCD to the National MUTCD with a state supplement. This procedures manual is written based on the National MUTCD and the NYS supplement.

JRP/DPH/dph

cc: T. Rice
J. Pond
B. Penwarden
D. Hrankowski
P. McComb
D. Fox
D. Wiegand
Others in MCDOT via electronic notice

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APPENDICES ON TRAFFIC ENGINEERING SURVEYS

ACCIDENT ANALYSIS

An accident analysis is a comprehensive traffic engineering study that reviews accident reports, identifies accident patterns, as well as any highway safety issues and problems, and proposes possible counter-measures. Some of the various components of an accident analysis are presented in the following.

PROBLEM IDENTIFICATION

1. Determine the location to be studied and why it is to be studied.

    a) Requested in-house
    b) Requested by the public (police, elected official, citizen, etc.)
    c) High accident location (Priority Investigation Location)

2. Determine the time period of accident analysis. Usually 3 consecutive years of accident data is sufficient.

3. Obtain the accident reports (MV-104's) over the time frame determined to be appropriate.

4. If the study is a linear P.I.L., we get the accident reports for the entire area to update the accident timeframe, obtain the latest reportable rates and obtain the non-reportable accidents, determine where the rates continue to exceed the critical rate, and then focus on those areas.

PROCESSING ACCIDENT REPORTS

Once all accident reports are received, it is necessary to present the data in as concise a form as possible while including all pertinent details.

1. Use the COLLISION DIAGRAM REFERENCE SHEET (Figure 1) and COLLISION DIAGRAM (Figure 2). The collision diagram presents a diagrammatic view of each accident. Vehicles are represented by arrows drawn in the direction of travel in the general location of the accident. For example, to represent a collision of 2 vehicles on a roadway, 2 arrows are drawn on the diagram that meet each other in the same manner that the actual collision occurred on the roadway. If possible, all collisions for the same year are drawn on the same diagram.

2. Label all accident reports with a reference number sequentially in chronological order. Number them beginning with the earliest date and ending with the latest date. Label the individual accidents on the collision diagram with the same reference number that corresponds to its accident report. Use the same number again on the COLLISION DIAGRAM REFERENCE SHEET. The reference number identifies each accident. The information on the collision diagram reference sheet documents each accident in concise format. An accident record on the reference sheet is one line containing the following information.

Figure 1 - Collision Diagram Reference Sheet Example

Broad St Exchange St

2 Years, 7/1/03 - 6/30/05

Collision Diagram Reference

File:Broad St Exchange St

#	Type	Dir	Time	Day	Date	Severity	Comment
1	SS	S	1215	Th	17Jul03	pdo	passng/lane us improper;20' S/O Broad
2	PKD	S	2145	We	30Jul03	pdo rpt	exiting pkg space;unsafe lane change;75' S/O Broad
3	PKD	E	1245	Fr	01Aug03	pdo	entering pkg space;100' E/O Exchange
4	LT	N	2020	Th	07Aug03	3-inj-C	failure to yield ROW
5	PKD	S	1120	Tu	23Sep03	pdo	exiting pkg space;100' S/O Broad
6	LT	N	0930	We	24Sep03	pdo rpt	failure to yield ROW
7	PKD	S,Wlt	1613	Th	25Sep03	pdo	driver inattention,wide LT;50' S/O Broad
8	RE	N	1230	Sa	04Oct03	pdo	following too closely;avoiding uninvolved veh;20' S/O Broad
9	RE	E	1740	Th	09Oct03	1-inj-C	driver inattention
10	RE	S	1718	Th	18Dec03	pdo	following too closely;50' S/O Broad
11	LT	N	1145	Mo	05Jan04	pdo rpt	failure to yield ROW
12	RTWL	S	1229	Tu	20Jan04	pdo	turning improperly,dual RT
13	RE	N	0018	Su	25Jan04	pdo	slippery pavement
14	RE	S	1645	We	10Mar04	pdo rpt	avoiding uninvolved pedestrian;75' S/O Broad
15	PKD	E	1448	We	30Jun04	pdo	unsafe backing,into pkg space;20' W/O Exchange
16	RA	N,Wlt	0952	Mo	12Jul04	2-inj-C	failure to yield ROW by Wlt
17	LT	S	2240	Th	05Aug04	3-inj-B	failure to yield ROW;20' E/O Exchange @ int
18	LT	N	1120	Fr	03Sep04	pdo rpt	failure to yield ROW
19	LT	N	0853	Th	23Sep04	3-inj-C	failure to yield ROW;10' W/O Exchange @ int
20	RE	E	2258	Tu	05Oct04	pdo	following too closely;25' E/O Exchange
21	PED	S,Wpd	0645	Mo	29Nov04	1-inj-C	ped error xing S leg E to W
22	RA	E,N	0715	We	08Dec04	1-inj-C	traffic control disregard by EB
23	PKD	E,Ert	1201	We	05Jan05	pdo	driver inattention;hit RT as exiting pkg space
24	LT	N	1704	Tu	11Jan05	pdo	failure to yield ROW
25	LT	N	1635	Fr	04Feb05	pdo rpt	failure to yield ROW
26	LT	N	1251	Mo	28Feb05	pdo rpt	failure to yield ROW
27	LT	S	1637	Su	03Mar05	pdo rpt	failure to yield ROW
28	SS	W	1807	Mo	18Apr05	pdo rpt	improper turning
29	LT	N	1020	Tu	26Apr05	pdo	failure to yield ROW
30	LT	E	1740	Fr	06May05	pdo rpt	failure to yield ROW
31	UTRN	W,Wut	1323	Su	22May05	pdo rpt	turning improperly;driver inexperience;20' W/O Exchange
32	RTOR	N,Wrt	1036	Sa	11Jun05	pdo rpt	failure to yield ROW;driver inattention

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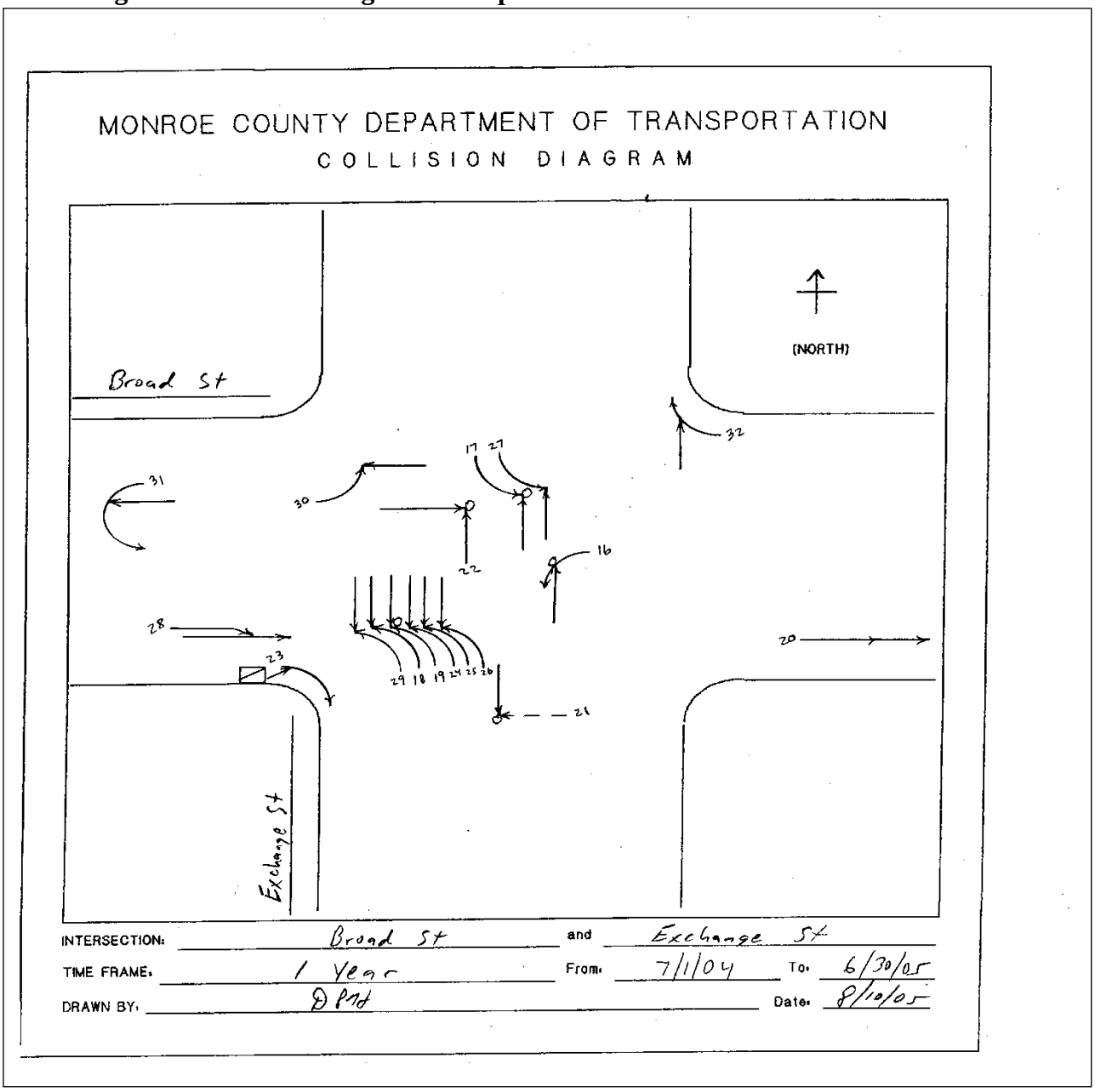
3. The collision diagram is usually hand-drawn, but the reference sheet can be either hand-written or typed into computer and printed. Both are labeled with identifying information such as location, North Arrow, time period, preparer and preparation date.

Figure 2 - Collision Diagram Example



4. By using a computer database program to prepare the reference sheet, it is possible to generate an "Accident Pattern Analysis" (Figure 3). This requires typing some additional information for each accident, such as type of accident and directions. A printed report can identify patterns such as type, direction, and time of day. The reference sheet and accident pattern analysis can be archived in the computer for future reference or additions.

Figure 3 - Accident Pattern Analysis Example

Broad St Exchange St **File:Broad St Exchange St**
2 Years, 7/1/03 - 6/30/05

Accident Patterns

LT

E

1740	Fr	06May05	pdo rpt	30	failure to yield ROW

N

0853	Th	23Sep04	3-inj-C	19	failure to yield ROW;10' W/O Exchange @ int
0930	We	24Sep03	pdo rpt	6	failure to yield ROW
1020	Tu	26Apr05	pdo	29	failure to yield ROW
1120	Fr	03Sep04	pdo rpt	18	failure to yield ROW
1145	Mo	05Jan04	pdo rpt	11	failure to yield ROW
1251	Mo	28Feb05	pdo rpt	26	failure to yield ROW
1635	Fr	04Feb05	pdo rpt	25	failure to yield ROW
1704	Tu	11Jan05	pdo	24	failure to yield ROW
2020	Th	07Aug03	3-inj-C	4	failure to yield ROW

S

1637	Su	03Mar05	pdo rpt	27	failure to yield ROW
2240	Th	05Aug04	3-inj-B	17	failure to yield ROW;20' E/O Exchange @ int

PED

S,Wpd

0645	Mo	29Nov04	1-inj-C	21	ped error xing S leg E to W

PKD

E

1245	Fr	01Aug03	pdo	3	entering pkg space;100' E/O Exchange
1448	We	30Jun04	pdo	15	unsafe backing,into pkg space;20' W/O Exchange

E,Ert

1201	We	05Jan05	pdo	23	driver inattention;hit RT as exiting pkg space

S

1120	Tu	23Sep03	pdo	5	exiting pkg space;100' S/O Broad
2145	We	30Jul03	pdo rpt	2	exiting pkg space;unsafe lane change;75' S/O Broad

S,Wlt

1613	Th	25Sep03	pdo	7	driver inattention,wide LT;50' S/O Broad

RA

E,N

0715	We	08Dec04	1-inj-C	22	traffic control disregard by EB

N,Wlt

0952	Mo	12Jul04	2-inj-C	16	failure to yield ROW by Wlt

RE

E

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FIELD REVIEW (also see Appendix B)

The field review documents physical conditions as they actually exist at the location under study. It is important to show all the existing roadway features exist on a condition diagram. Examples of

features shown on this diagram include, curbs, striping and markings, lights, signs, signals and timing, driveways, parking, curves, hills, sight distance, lane width, etc. Generally, anything

having a bearing on vehicles and drivers should be shown on the condition diagram just as it exists in the field. Traffic characteristics should be observed at the site and noted, as well as neighborhood characteristics (commercial, residential or suburban, etc.). Usually, it is a good idea to drive through the location several times in different directions to "get a feel" for what the average driver encounters at the site.

A powerful tool now available is Pictometry. This is a database of aerial photographs that covers the entire county. Close in (or "neighborhood") views and wide angle (or "community") views, shot at orthogonal and oblique angles, are available. This tool can be used to scale off distances, determine vertical profiles, and locate features precisely, as well as to provide a comprehensive picture from overhead.

Another powerful tool is the County Roadway Video Log. This is a library of windshield level video clips taken as the road is being driven in one direction. For four lane roads, both directions are imaged. These video clips are useful for identifying signs, striping, surface features, etc.

PROBLEM ANALYSIS AND REPORT

After collision diagrams are prepared and a field review is conducted, these materials should be reviewed to determine if any appropriate additional studies are needed before a report is written. Additional data needed to aide in the development of conclusions could include traffic volume and/or speed studies, vehicular delay studies, ballbank studies, or any of the traffic surveys detailed in the appendices.

After all appropriate data is collected a report should be prepared. The report should state the location, an introduction summarizing why the location is being studied, list site visits and other data collection efforts, discuss the findings, and present conclusions and recommendations. If there are deficiencies in the physical features, they should be discussed, as well as any accident patterns, traffic patterns, etc., which impact the location and how we evaluate it. If a problem is identified, then options for improvement should be identified and discussed. A reasonable recommendation may be apparent, and should be stated. However, just as often, a practical counter-measure is not apparent and the appropriate recommendation is no action.

Often, improvement options can be uncovered by consulting a General Table of Accident Countermeasures. Such a table matches appropriate traffic engineering countermeasures to existing accident patterns. Tables can be found in the *Safety Investigation Procedures Manual*, Traffic Safety Division, NYSDOT, and in *Identification, Analysis and Correction of High Accident Locations*, USDOT, FHWA. However, the tables need to be applied to the location and are by no means an exhaustive list of corrective measures.

FOLLOW-UP STUDIES

Often, problems can recur at the same location in the future, even after an accident study has been completed and changes have been made to the road. For this reason, records of past accident

studies are useful as a starting point for future studies. One of the recommendations that should be considered is whether or not a follow-up study needs to be done and how long a time period should elapse before the follow-up study is done. Some rules of thumb on when a follow-up study should be done are as follows:

If Remedial Action is Deferred

- When an accident pattern identified at the beginning of the accident history reviewed is not shown later in the period and no specific reason is evident (i.e. – no traffic diversions, no trees/bushes blocking sightlines that were later trimmed, etc.) and a proposed change is postponed to see if the pattern returns. In this case, the location should be restudied after an appropriate time period to see if the pattern returns.

- When an accident pattern is identified late in the accident history reviewed that is not shown earlier in the period and a specific reason is evident (i.e. – traffic diversions, trees/bushes blocking sightlines that need to be trimmed, etc.). In this case, the location should be restudied after an appropriate time period to see if the pattern continues after the condition theorized to cause it is removed.

If Remedial Action is Taken

- When a lesser, interim measure is implemented in lieu of implementing a more radical measure. An example of this is if a strong right angle accident pattern has been identified at a two-way stop controlled intersection and, based on the details in the accident reports, it is decided to try reinforcing the existing stop signs (i.e. – install overhead flashers, larger or dual stop signs, stop bars, etc.) rather than going to an all way stop control. In this case, a follow-up study should be conducted to determine if the lesser measure was effective. If not, the more radical measure may be needed.

- When a new measure is being tried whose effectiveness may not be known. Such an after study can help to identify whether or not the device worked and if it should be tried elsewhere.

The appropriate time period to wait before restudying the location can vary from six months to two years. Less than six months is not long enough to show meaningful patterns and longer than two years can allow immediate safety problems to continue too long. Exactly how long should be based on the severity of the accident patterns identified, the measures implemented, and when opportunities for geometric improvement (i.e. – resurfacing or reconstruction) are scheduled.

ALL WAY STOP CONTROL

Policy

The MCDOT evaluation of requests for all way stop control (AWSC) includes evaluation of the MUTCD and the San Diego warrants for installation of all way stop control. The warrants are used to avoid the proliferation of stop signs, which, in the long run, invites non-compliance of all stop signs. We often get requests for AWSC as a speed control measure. The MUTCD specifically states that stop signs are not to be used for speed control, but instead are used to designate the legal right of way of motorists at intersections. In addition, national and local traffic studies show stop signs can actually be counter-productive in controlling speed. While speed is reduced in the immediate vicinity of the stop sign, speeds may be actually higher between intersections as drivers make up for lost time. AWSC is also very inefficient when the volumes on the two intersecting roadways are considerably different.

Introduction

The MUTCD has guidelines for installation of an AWSC; however, we believe that these guidelines alone may be too stringent for meeting the need in urban areas. Therefore, Monroe County initiated nationwide research into what other municipalities use to determine if AWSC is warranted.

We discovered that the City of San Diego Department of Engineering and Development developed an AWSC policy that considers a variety of categories: accidents, unusual conditions, traffic volumes, and pedestrian volumes. Each category contributes points to a total, which may justify AWSC for an intersection. We believe this system to be more flexible than the MUTCD guidelines, which require warrants for at least one category to be satisfied in full. The San Diego policy was adopted by the City of Rochester's Traffic Control Board in November, l990 as part of an overall policy on neighborhood traffic control that is covered in the following section.

Even with this new policy, the MUTCD should always be consulted to determine if AWSC is justified under MUTCD warrants.

MUTCD Warrants for AWSC

Any of the following conditions must be met in full to warrant AWSC.

1. As an interim measure until a signal is installed.

2. Five correctable type accidents within a 12 month period. Such accidents include turning collisions as well as right angle collisions. The twelve month period can be any consecutive twelve months, not just within a calendar year.

3. A total of at least 2400 vehicles entering the intersection from the major street approaches during any eight hours of an average day AND at least 1600 vehicles/pedestrians/bicyclists

   entering the intersection from the minor street approaches during the same eight hours, AND side street delay averaging at least 30 seconds during one hour. If the 85^{th} percentile speed of

traffic approaching on the artery is at least 40 MPH, the above minimum volumes are reduced to 1680 and 1120 vehicles respectively.

San Diego Warrants for AWSC

The San Diego Warrants for AWSC are met when a total of at least 25 of a possible 50 points are assigned over five criteria based on the traffic data gathered. Within the City of Rochester, the warrants are met when at least 25 of a possible 55 points are assigned over six criteria. The warrant criteria and points assigned are as follows.

Warrant	Points	Possible
1. Accident Experience (one year) From __ /__ /__ to __ /__ /__ Acc/Year Correctable by Stops x 3	__	15
2. Unusual Conditions _____ _____ _____ _____ (Points are assigned based on engineering judgement)	__	5
3. Traffic Volumes (Peak 4 Hours)		
Major Approaches _____	__	5
Minor Approaches _____	__	10
4. Traffic Volume Difference	__	10
5. Pedestrian Volume Pedestrians crossing the major street during 4 hour count	__	5
6. Nearest Stop Control (greater than .5 miles up to 5 pts.)	__	5 (Within the City only)
TOTAL Points Required 25	___	55 (50 outside City)

Outline of Warrant Criteria

1. Accident Experience - maximum 15 points. Three points are assigned for each correctable accident that occurred in a recent preceding 12-month period. The City of Rochester specifies the latest 12 months reviewed. MCDOT considers this period as well, but may use a 12 month period within the last two years that has higher occurrence. This decision is based on engineering judgment.

2. Unusual Conditions - maximum 5 points. Points are assigned for unusual conditions based on engineering judgment. The point value assigned to each condition should be correlated to the improvement to the situation that all-way stops would provide. "Speed control" should never be a basis for awarding points.

3. Traffic Volumes - maximum l5 points as follows.

MAJOR STREET (4-hour count)	Points	MINOR STREET (4-hour count)	Points
0-1000	0	0-400	0
1000-1300	1	401-600	1
1301-1600	2	601-800	2
1601-1900	3	801-1000	3
1901-2200	4	1001-1200	4
2201-2600	5	1201-1400	5
2601-2900	4	1401-1600	6
2901-3200	3	1601-1800	7
3201-3500	2	1801-2000	8
3501-3800	1	2001-2200	9
3801-over	0	2201-over	10

4. Traffic Volume Difference - maximum 10 points as follows:

Volume Difference (4-hour count)	Points	Volume Difference (4-hour count)	Points
0-150	10	751-900	5
151-300	9	901-1050	4
301-450	8	1051-1200	3
451-600	7	1201-1350	2
601-750	6	1351-1500	1
		1501-over	0

5. Pedestrian Volumes - maximum 5 points. One point is assigned for each set of 50 pedestrians in four hours.

6. Nearest stop control (Within the City only) - maximum 5 points.

   .5 to .6 miles - 2 points
   .6 to .7 miles - 3 points
   .7 to .8 miles - 4 points
   over .8 miles - 5 points

AUTOMATIC TRAFFIC COUNTER PROGRAM

MCDOT has designated a total of approximately 960 locations on County roads and on arterial/major collector roads in the City at which we periodically update vehicular traffic counts via automatic traffic recorder (ATR). They are midblock locations near major intersections. The data is collected on normal weekdays over a minimum of 24 hours and up to 72 hours. The data collected is summarized and entered into the Monroe County Traffic Summary on an annual basis. ATR data collected in response to requests and as part of traffic studies, or provided by consultants, is also entered into the traffic summary. The traffic data entered includes ADT, two-way peak hour volume, one-way peak hour volume, and peak hour factor. This data has many uses. Some examples are the calculation of accident rates as part of traffic studies and the High Accident Location Program, corridor capacity analyses and design reports, prioritization of roads for snow/ice removal, pavement management, and for use by developers.

Figure 4 - Automatic Traffic Recorder Count

NODE 101833
WEGMAN RD.
LYELL RD.S.OF
CHAN A=SB,CHAN B=NB

Monroe County
Dept. of Transportation
Traffic Engineering

Site Code : 000010183351
Start Date: 05/16/2005
File I.D. : 101833
Page : 2

Begin	Wed.	1		2		Combined		Thur.	1		2		Combined	
Time	05/18	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	05/19	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
12:00		5	64	14	96	19	160		10	62	7	89	17	151
12:15		5	93	3	84	8	177		8	77	6	69	14	146
12:30		6	67	6	103	12	170		3	65	1	72	4	137
12:45		8	96	2	67	10	163		2	80	6	82	8	162
01:00		3	75	2	87	5	162		3	100	10	67	13	167
01:15		2	65	2	81	4	146		6	89	4	68	10	157
01:30		2	76	3	93	5	169		4	87	2	87	6	174
01:45		2	86	0	112	2	198		1	70	1	81	2	151
02:00		2	81	4	95	6	176		1	86	5	92	6	178
02:15		0	86	2	116	2	202		3	78	7	142	10	220
02:30		0	112	4	124	4	236		0	98	7	119	7	217
02:45		3	102	1	91	4	193		6	115	24	112	30	227
03:00		0	111	1	137	1	248		1	104	15	114	16	218
03:15		3	94	2	136	5	230		2	92	7	97	9	189
03:30		0	101	2	123	2	224		4	104	4	118	8	222
03:45		0	100	0	117	0	217		4	96	2	108	6	204
04:00		2	88	2	114	4	202		3	87	4	109	7	196
04:15		4	92	3	105	7	197		0	103	1	114	1	217
04:30		4	95	3	124	7	219		5	80	4	109	9	189
04:45		7	85	3	86	10	171		5	95	5	137	10	232
05:00		7	105	3	111	10	216		4	86	4	102	8	188
05:15		4	101	6	132	10	233		6	111	4	120	10	231
05:30		11	112	9	110	20	222		11	92	12	113	23	205
05:45		27	127	23	95	50	222		25	97	12	94	37	191
06:00		31	116	14	139	45	255		26	142	23	128	49	270
06:15		18	95	21	112	39	207		19	116	20	116	39	232
06:30		39	108	27	95	66	203		32	104	29	89	61	193
06:45		82	106	42	91	124	197		85	105	39	77	124	182
07:00		147	77	38	71	185	148		138	81	37	88	175	169
07:15		120	55	65	79	185	134		115	88	75	59	190	147
07:30		103	69	64	87	167	156		106	66	77	91	183	157
07:45		156	72	64	78	220	150		145	80	53	68	198	148
08:00		91	58	62	74	153	132		118	75	95	139	213	214
08:15		71	77	48	95	119	172		82	63	61	113	143	176
08:30		68	53	53	56	121	109		80	55	62	57	142	112
08:45		106	47	90	76	196	123		83	58	73	59	156	117
09:00		69	49	64	59	133	108		74	35	63	57	137	92
09:15		51	42	68	47	119	89		48	51	71	41	119	92
09:30		69	36	57	47	126	83		67	33	65	59	132	92
09:45		65	35	82	50	147	85		62	40	60	47	122	87
10:00		66	29	74	23	140	52		72	23	71	29	143	52
10:15		73	16	51	18	124	34		72	22	72	20	144	42
10:30		72	25	75	20	147	45		71	15	75	22	146	37
10:45		56	18	95	23	151	41		72	17	78	22	150	39
11:00		65	17	59	24	124	41		56	22	78	22	134	44
11:15		71	19	70	17	141	36		63	13	81	16	144	29
11:30		77	13	70	13	147	26		70	7	82	22	152	29
11:45		82	21	87	11	169	32		79	8	87	12	166	20
Totals		1955	3467	1540	3944	3495	7411		1952	3473	1681	3868	3633	7341
Day Totals			5422		5484		10906			5425		5549		10974
% Total		17.9%	31.7%	14.1%	36.1%				17.7%	31.6%	15.3%	35.2%		
Peaks		07:00	05:15	10:30	03:00	07:00	05:15		07:00	06:00	11:00	02:15	07:15	05:30
Volume		526	456	299	513	757	932		504	467	328	487	784	898
P.H.F.		.84	.89	.78	.93	.86	.91		.86	.82	.94	.85	.92	.83

AUXILIARY LANES

Left Turn Lanes

The procedure in this section is out of the MCDOT Highway Access Guidelines. Left turn lanes on two lane roads at unsignalized locations should be considered when traffic volumes exceed those in Table I. Left turn lane warrants for four-lane intersections shall be determined from the nomograph on the following pages.

Warrants For Left Turn Lanes On 2 Lane Roads

Table I

Advancing Volume (V.P.H.) per lane

V.P.H. per lane Opposing Volume	5% LT's	10% LT's	20% LT's	30%LT's
		40 mph Operating Speed		
800	330	240	180	160
600	410	305	225	200
400	510	380	275	245
200	640	470	350	305
100	720	575	390	340
		50 mph Operating Speed		
800	280	210	165	135
600	350	260	195	170
400	430	320	240	210
200	550	400	300	270
100	615	445	335	295
		60 mph Operating Speed		
800	230	170	125	115
600	290	210	160	140
400	365	270	200	175
200	450	330	250	215
100	505	370	275	240

Example for the use of Table I

85th percentile speed is 50 mph, with the following volumes.

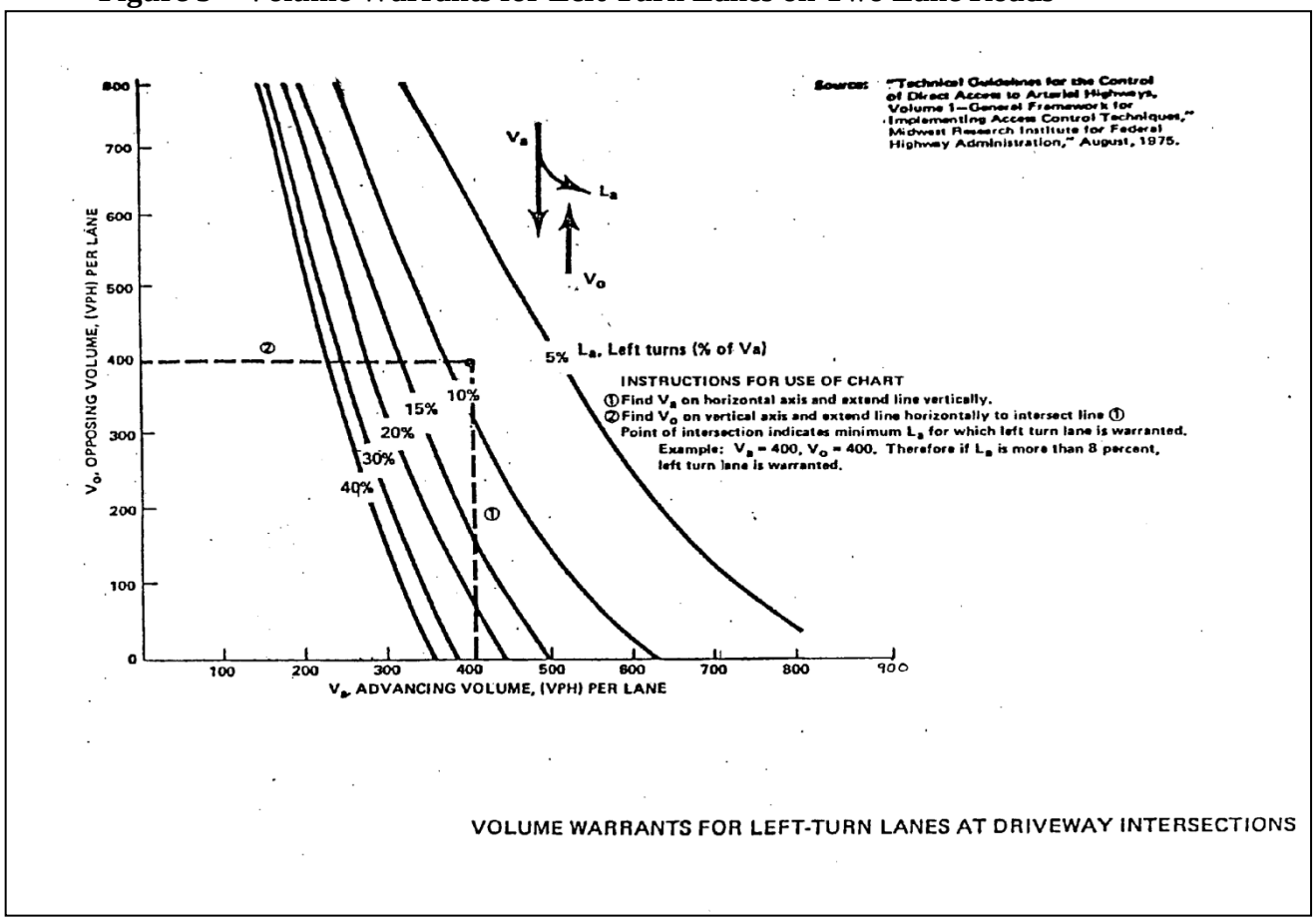
1. Use Table I for the corresponding speed, therefore, since the speed was 50 mph, use the middle table.

2. Find the volume opposing the left turns into the proposed subdivision in Column 1 opposing volume = 400 - Column 1, Row 3.

3. Find the advancing volume (throughs and lefts) on Row 3 of either Column 2, 3, 4 or 5. Advancing volume = 320 - Column 3, Row 3.

4. The heading for Column 3 is 10% left turns, therefore in order for a left turn lane to be warranted; at least 10% of the advancing volume must be turning left. 10% of 320 = 32, however our generated left turning volume is 15, therefore, a left turn lane is not warranted.

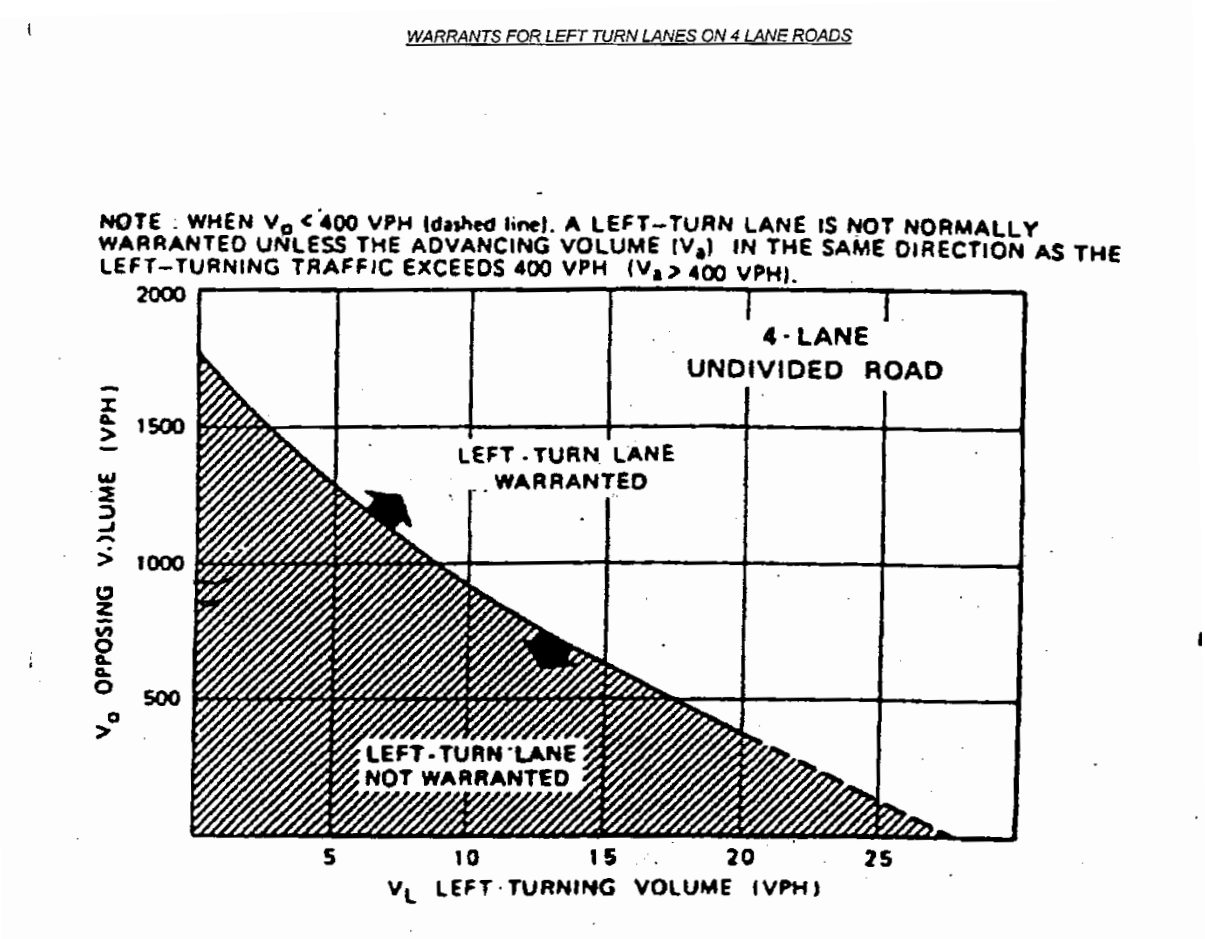
Figure 5 – Volume Warrants for Left Turn Lanes on Two Lane Roads



Warrants for Left Turn Lanes on 4 Lane Roads

To determine if a left turn lane on a four lane road is justified, use the graph below. If the plotted point falls above the line, a lane is warranted.

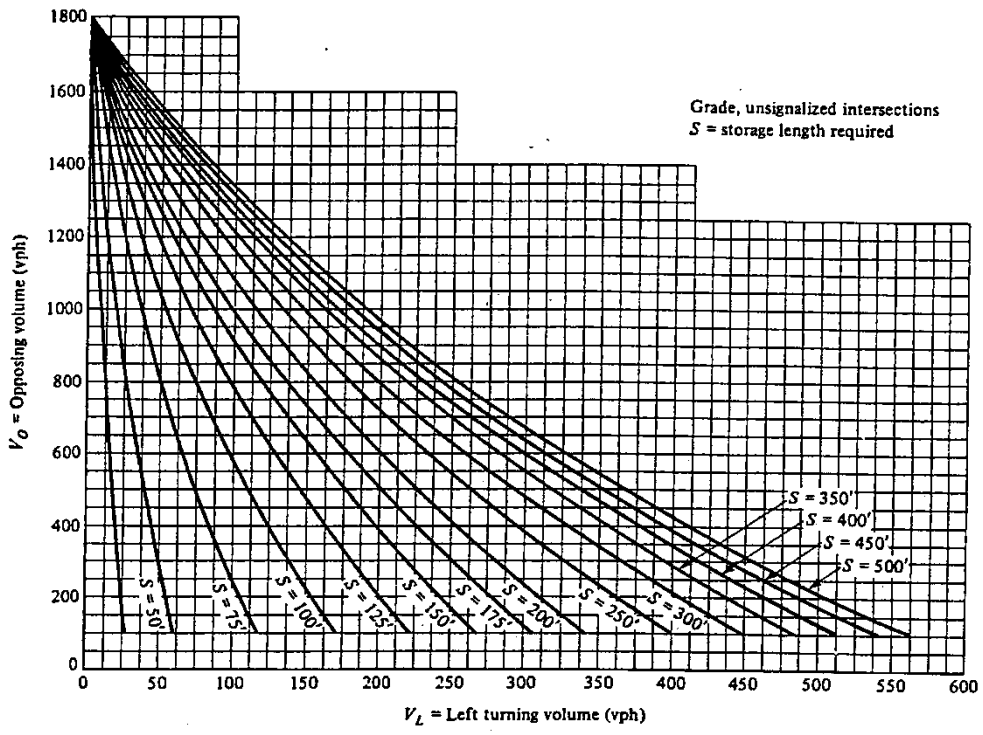
Figure 6 – Volume Warrants for Left Turn Lanes on Four Lane Roads



Storage Lengths of Left Turn Lanes at Unsignalized Locations

To determine the recommended storage length, use the graph that follows. The line closest to the plotted point is the minimum storage length required. The storage length can also be estimated by field observations and/or unsignalized capacity analysis. Storage estimates need to be made for both the auxiliary lane and the primary lanes. The design should be for the longer of the two.

Figure 7 – Storage Lengths of Left Turn Lanes at Unsignalized Intersections



Nomograph for left-turn storage at nonsignalized intersections. The nomograph is used by reading horizontally from the opposing traffic volume, V_O, on the vertical axis and reading vertically from the left-turn volume, V_L, on the horizontal axis and locating the minimum storage length, S, at the point where the horizontal and vertical lines cross. For example, 100 left-turning vehicles per hour, V_L, with an opposing through volume, V_O, of 950 vph, will require a minimum storage length of about 150 feet.

Storage Lengths of Left Turn Lanes at Signalized Intersections

To determine the required storage length at a signalized intersection, run a capacity analysis (MCDOT uses Synchro) and design for the predicted queue lengths. A design that accommodates the 95 percentile queue is desirable. Storage needs to be determined for both the auxiliary lane and the primary lanes. The design should be for the longer of the two.

Two Way Left Turn Lane (TWLTL) vs Left Turn Pocket at Driveways

If there are driveways on both sides of the road near the driveway or intersection being studied, a TWLTL may be preferable to a left turn pocket. If adjacent driveways on opposite sides of the road are less than 250 feet apart, or more than 21 driveways per mile, a TWLTL should be striped instead of left turn pockets. Two separate left turn pockets of minimum dimensions require at least 50 feet of storage each, two 50-foot inbound tapers, and 50 feet of separation for a total of 250 feet.

A TWLTL can also provide a good transition from a travel lane to a left turn pocket as well. If the pocket overflows, the TWLTL can provide additional storage needed during peak periods without

leaving excess pocket length during off-peak periods. A TWLTL also provides refuge for traffic coming out of the driveway(s) and allows them to merge into the travel lane when there is a gap.

On the approaches to a signalized intersection, normally it is good practice to provide a dedicated left turn lane approaching the signal instead of a TWLTL. The interruption of traffic caused by the signal makes it important to provide refuge for a left turning vehicle without allowing an opposing vehicle to occupy that space.

Right Turn Lanes

There are no specific warrants for right turn lanes, but MCDOT sets a peak right turn volume of 300 vehicles per hour as the threshold above which a right turn lane should be considered. The minimum storage length required can be estimated by field observations and/or unsignalized capacity analysis. Consider the storage needs of both the primary and auxiliary lanes, and use the longer of the two as the length needed.

"CHILDREN AT PLAY" SIGNS

Policy

These signs are not in the National MUTCD but are in the NYS supplement.

"Children at Play" signs should be limited to locations where, because of unusual conditions, motorists might not expect children playing in the vicinity of the roadway. The "Children at Play" sign is not intended for general use in residential areas, or on other highways where obvious residential development alerts motorists to the possibility of children at play. These signs should be used carefully, so that the parents and children do not get a false sense of security.

Guidelines

All requests for "Children at Play" signs shall proceed with the following studies:

1. Field Review

   A field review to identify the type and mix of development in the area. The reviewer should also determine if it would be immediately apparent that children may be present.

2. Speed Study (Optional)

   A speed study conducted with counters or radar unit may be done to determine the prevailing speeds on the subject roadway. Speeds may also be estimated as excessive by field observation and engineering judgment.

Criteria

"Children at Play" signs may be posted if a field review of the area reveals development that is a mix of commercial/industrial with residential dwellings. They may also be appropriate when there is an unexpected change along the road from a non-residential to a residential area that is not apparent to the driver. Signs used for this purpose should be posted just prior to this change as a warning to drivers. If speeds are a problem (85th percentile speed $\geq$ 35 MPH in the City) and the development is obviously residential, other measures such as speed limit signs are more appropriate.

CROSSWALKS - MARKED

I. Responsibility

For County roadways, the installation and maintenance of crosswalk markings are under the Town's jurisdiction at both signalized and unsignalized locations. However, MCDOT must approve their installation across County roadways as deemed justified by an engineering analysis. Markings covered over due to any paving or resurfacing work will be the responsibility of the agency that did the work. Crosswalks in the City are under City jurisdiction. Currently, the City contracts with MCDOT to install/maintain/remove the markings and we also provide our traffic engineering expertise to the City. MCDOT owns and maintains all of the signs in the City and County.

II. Engineering Analysis for Crosswalks

There are advantages and disadvantages of marked crosswalks.

Advantages include:

- Helping to guide pedestrians across complex intersections and midblock locations.
- Designating the preferred path.
- Directing pedestrians to the location with best sight distance.

Disadvantages include:

- Possibly creating a “false sense of security” for pedestrians. Normal caution and proper crossing procedures still need to be exercised.
- Possibly generating a greater number of pedestrian collisions (compared to unmarked crossings) at uncontrolled locations on multilane streets with high traffic volume or high approach speeds.

All requests for a marked crosswalk shall proceed with some or all of the following studies.

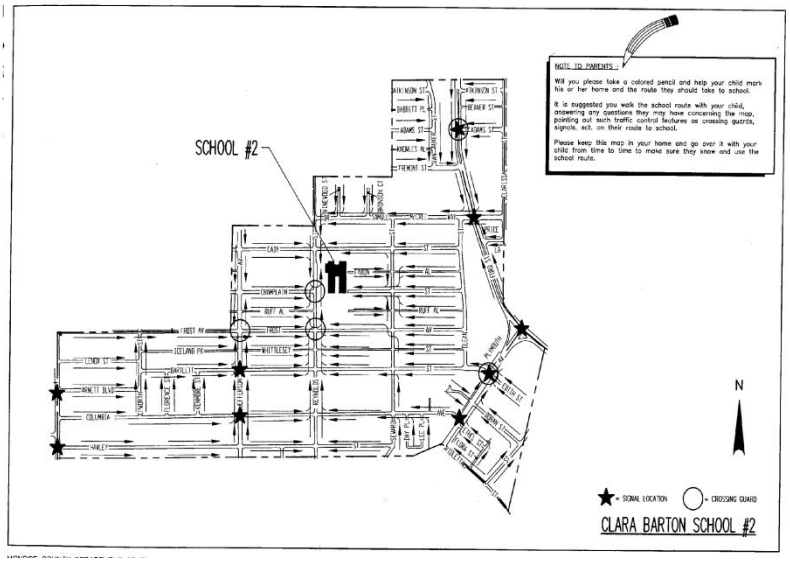
- Field review to identify existing signs, traffic controls, sight distance, and alternate crossing points
- Speed study of approaching vehicular traffic
- Pedestrian traffic counts
- Gap analysis study
- Possibly a special study type for unusual locations and/or traffic conditions

III. Additional Considerations

1. School Crossing

- If the request is in the city, the Safe School Route Map (see Figure 8) is consulted to determine if school children are directed to cross at the location. If outside the City, the school district and the town will need to be consulted to identify designated school crossings.

Figure 8 – Safe School Route Map



- Install at all designated school crossings at signalized intersections.

- Install across approaches controlled by a stop sign if a crossing guard exists or if the intersection is a pedestrian concentration point immediately adjacent to the school.

- Install midblock across the major street where no controls exist and students are designated to cross, and either adequate gaps exist or an adult crossing guard is present.

2. Multi-use Paths

Crossing locations where a multi-use path crosses a roadway should automatically be considered for crossing treatments regardless of pedestrian volumes. This is to promote the use of multi-use paths recognizing that roadway crossings often create barriers for pedestrians and bicyclists and may contribute to lack of use.

3. Sidewalk System Continuity

If there is a point where the sidewalk system either changes sides or changes from both sides to one side, crossing treatments should be considered at or near that point. The crosswalk would prompt pedestrians walking from sidewalk on both sides to sidewalk on one side to cross the road to the side where the sidewalk continues. New York State

Vehicle & Traffic Law requires that pedestrians walk on sidewalk when it is available on either one or both sides. Walking against the directional flow of vehicular traffic either on a shoulder or in the road is allowed only when there is no sidewalk on either side.

4. Controlled Locations

- Marked crosswalks should be considered near pedestrian generators. Pedestrian generators include retail, parking lots, parks, churches, schools, restaurants, theaters, etc.

- To guide pedestrians as to the correct legs to cross at signalized intersections (i.e. – where there are pedestrian signals, fewest conflicts, etc.).

- At locations where vehicular traffic might block pedestrian traffic when stopping for a stop sign or red signal.

- To guide pedestrians crossing at an uncontrolled midblock location nearby to cross instead at the controlled location to take advantage of the gaps created by the control.

5. Uncontrolled Locations

Crossings at uncontrolled locations should be marked where all of the following are the case.

- Sufficient demand exists to justify the installation of a crosswalk.

    - The crosswalk would serve a number of pedestrians (ideally at least 20 pedestrians) per hour during the peak hour (15 if pedestrians are elderly or children) or 60 pedestrians total for the highest consecutive four hour period, OR

    - The crossing is a direct route to/from a pedestrian generator and serves at least some pedestrians. Use engineering judgment when evaluating this criterion.

- The location is at least 150 feet in a Central Business District (CBD) area, or 300 feet elsewhere, away from another crossing location (controlled or uncontrolled). If the nearest crossing is less than 150/300 feet away, the pedestrian volume should be at least two times the minimum.

- The location has sufficient sight distance that exceeds the minimum stopping sight distance as defined by AASHTO.

- The location is not adjacent to or near a school where it could redirect school walkers away from the designated school crossing point.

- Other safety considerations do not preclude use of a crosswalk. Crosswalks at uncontrolled crossing locations that are multilane, have very low gap availability, or high vehicular approach speeds may not be desirable for pedestrian safety and mobility. Use engineering judgment when evaluating this criterion.

IV. Recommended Crossing Treatments

1. Table of Treatments

   Once it is determined that the criteria for crosswalk installation is met, the next step is to determine the appropriate level of treatment using the table on the next page. The table specifies progressive levels of treatment for locations as gap availability decreases, approach speeds go over 40 MPH, and if the roadway is multilane. If the crossing location is a designated school crossing, all signs must be Fluorescent Yellow Green (FYG) as required by the MUTCD.

2. In-Street "State Law - Yield to Pedestrians Within Crosswalk" Signs

   MCDOT does not install or maintain in-street "State Law – Yield to Pedestrians within Crosswalk" signs. Requests of MCDOT for in-street "State Law - Yield to Pedestrians within Crosswalk" signs at crosswalks in the City of Rochester should be referred to the City for evaluation of the City's written policy on these devices. Requests on County roadways outside the City are also evaluated based on the City's criteria. If use of the devices is endorsed by MCDOT, the request will be referred to the Town for concurrence because the Town has ownership of the crosswalks on County roadways. Should the Town concur, they would have to obtain a no fee highway permit from MCDOT, purchase signs whose construction and materials comply with the MUTCD, and install/maintain/remove the signs in compliance with the MUTCD and our policy/special conditions.

3. ADA Compliance

Where installation of crosswalk markings is approved, suitable access to the crosswalk for handicapped and visually impaired pedestrians has to be facilitated by the installation of sidewalk curb ramps per ADA requirements. Installation of ramps is the responsibility of the City or Town. The ramps are to be constructed in compliance with either City or MCDOT construction specifications and details, depending on jurisdiction. The crosswalk markings may be installed ahead of the ADA ramps if the exact ramp locations are known and construction of the ramps is pending.

Table of Possible Marked Crosswalk Treatments for Unsignalized Locations

Gaps[1]	85th % Speeds[1]	# Lanes[1]	Crosswalk Markings[3]	Crosswalk Signs	Geometric Features[6] (to consider)	Additional Control (to consider)
Adequate[2]	Under 40 MPH	3 or less	Standard (STD) Crosswalk	Standard (STD) Yellow advance and crossing; Fluorescent Yellow Green (FYG) at a school crossing		
		4 or more	STD	STD or Enhanced[4] Yellow advance and crossing; Enhanced[4] FYG at a school crossing		
	40 MPH +	3 or less	STD or Continental	STD FYG advance and crossing		
		4 or more	STD or Continental	STD or Enhanced[4] FYG advance and crossing		
Inadequate[2]	Under 40 MPH	3 or less	STD	STD FYG advance and crossing	Edgeline, bump-outs or islands	
		4 or more	STD or Continental	STD or Enhanced[4] FYG advance and crossing	Edgeline, bump-outs or islands	Flasher[5] or Signal (if warranted)
	40 MPH +	3 or less	STD or Continental	STD or Enhanced[4] FYG advance and crossing	Edgeline, bump-outs or islands	Flasher[5] or Signal (if warranted)
		4 or more	STD or Continental	Not allowed at a Signal	Not needed at a Signal	Signal (if warranted)

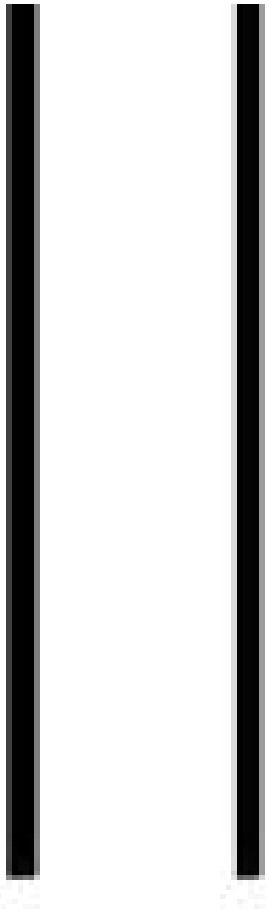
1. If a median usable as a pedestrian shelter exists, each direction of traffic is treated separately. The direction with the more unfavorable traffic conditions (fewer gaps, higher speeds, or more lanes) determines the level of devices installed in both directions.
2. Gaps are considered to be adequate if there are at least 60 gaps in traffic available during the peak hour long enough to cross the street at the proposed crosswalk location. If gaps are inadequate, a crosswalk is still marked but the level of treatment is higher.
3. Crosswalks markings are either Standard or Continental (higher visibility); see next page for figures. An existing standard crosswalk is adequate where continental is required until the next resurfacing/restriping opportunity. Where a textured crosswalk is used, standard crosswalk markings are also used.
4. Enhanced signs are defined as either oversized or double posted signs. Whether or not to use them, and which enhancement, is based on engineering judgment.
5. "Flasher" represents either flashing beacons on ground mounted signs (lower speeds/widths), or overhead mounted flashing beacons at the crosswalk (higher speeds/widths). Flashers can be used instead of or in conjunction with enhanced FYG. The choice is based on engineering judgment.
6. Bump-outs or islands are installed only if feasible and if a construction opportunity presents itself. Edgeline also reduces the effective pavement width the pedestrian must cross and thus creates gaps.

Other possible treatments that could be used in conjunction with treatments summarized above include:

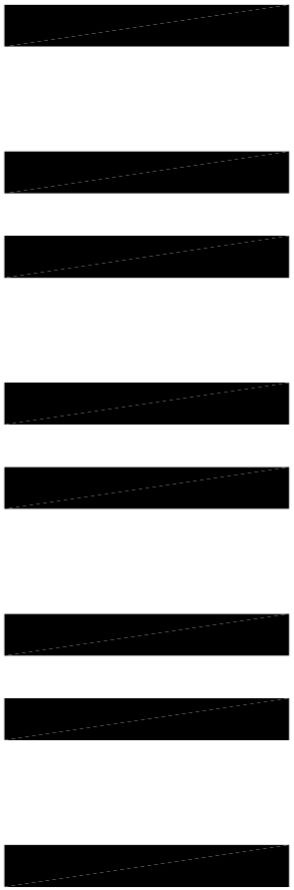
- Advance yield lines plus "Yield Here to Pedestrians" signs
- In-Street "State Law - Yield to Pedestrians within Crosswalk" signs used as per the City/County policy.

Crosswalk Types Used by MCDOT

Standard*



Continental



*** Standard crosswalk also applicable when a textured crossing is installed**

CURB EXTENSIONS

The intent of using curb extensions or "bump-outs" is to improve safety for pedestrians through a reduced crossing distance, improve safety for vehicles at unsignalized intersections on the stop-controlled side street by allowing them to advance further out where the view may be better and to assist in calming traffic. Because the bump-outs also recess parked vehicles, there may be opportunities for creating parking while providing a raised physical feature that prevents illegal parking too close to the intersection. There should still be enough sight distance to minimally provide stopping sight distance thus allowing the primary street traffic to stop in time to avoid an accident. In most cases, recognizing the need for creating as much parking as possible in urbanized areas (i.e. – City of Rochester), we suggest using a 30 MPH design speed and the stopping sight distance criteria. Minimum stopping sight distance should also be provided at signalized intersections to accommodate the right turn on red movement.

In the AASHTO publication A Policy on Geometric Design of Highways and Streets (or "Green Book"), the standard for measuring intersection sight distance assumes that the driver is sitting approximately fourteen feet behind the edge of the travel lane. That is six feet from the travel lane to the front bumper plus eight feet from the bumper to where the driver is sitting. This is a guideline and may be realistic for new developments. However, for existing intersections and particularly under highly urbanized conditions, a driver sitting fourteen feet back would probably not be able to see along the major street due to fixed obstructions on the corners and would advance as far forward as possible without entering the intersection. Therefore, for the purposes of this bump-out policy, we assume that the driver would be sitting ten (10) feet behind the edge of the travel lane. We also assume the driver sits approximately three feet offset from the centerline on an unsignalized approach. Applying the full AASHTO policy is not practical due to the substantial impact on parking and urban street features.

Table II lists the total parking clearance needed to achieve the minimum stopping sight distance at an unsignalized intersection with some general geometric parameters. This parking clearance can either be achieved by constructing the bump-out to this length, or by adding enough parking clearance to the bump-out's length to achieve this distance. A full length bump-out is preferable because parking enforcement is not needed to maintain the parking clearance. Additional lengths may be desirable where the prevailing speeds are higher.

Table II
Parking Corner Clearance Required To Achieve Minimum Stopping Sight Distance

			[1]Skew Right 25°		No Skew		[2]Skew Left 25°	
Speed	Bump-out Width	Lane Width	Looking Left	Looking Right	Looking Left	Looking Right	Looking Left	Looking Right
30 MPH	6 Foot	11 ft	95 ft	75 ft	110 ft	85 ft	105 ft	80 ft
		13	85	70	95	80	90	75
		15	75	65	85	70	80	70
	8 Foot	11	90	70	95	80	95	75
		13	80	65	90	70	85	70
		15	70	60	75	65	70	60
35 MPH	6 Foot	11	120	95	135	110	135	105
		13	110	90	120	100	115	95
		15	100	80	105	95	105	85
	8 Foot	11	115	85	125	100	120	95
		13	100	85	110	95	105	90
		15	90	70	100	85	90	80

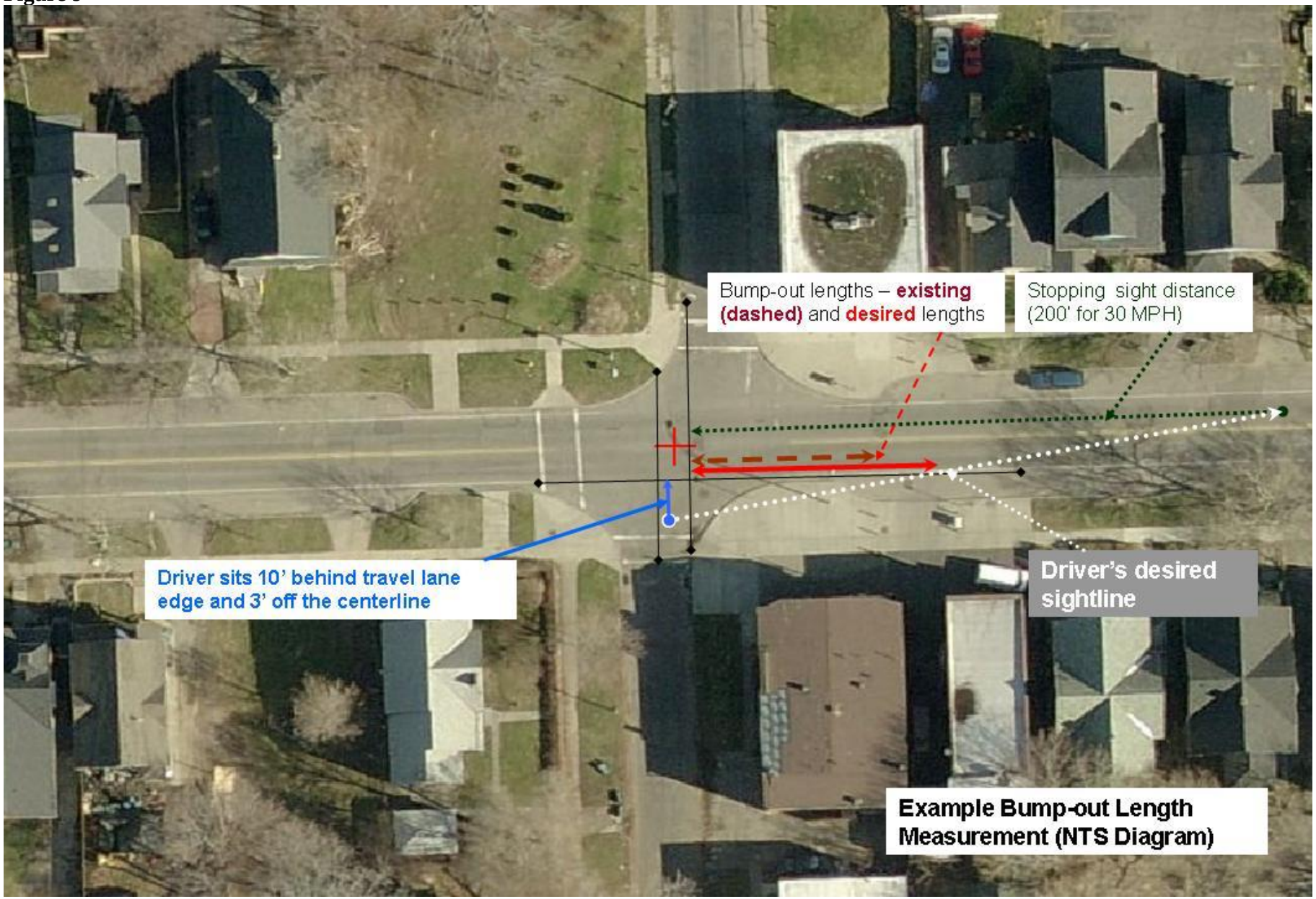
For notes 1 and 2, see the diagrams below

[1] Inbound side street approach skewed to the right

[2] Inbound side street approach skewed to the left

The clearance and/or bump-out length required for the approach speed will vary with the bump-out width, approach lane widths, and degree/direction of intersection skew. While the values in Table II can be used as a general guide, Figure 9 illustrates a general procedure to determine the required clearance for any unsignalized intersection configuration. In addition, for clearance at a signalized intersection for a right turn on red, engineering judgment should determine where the driver would be sitting. Drivers tend to start their right turn before stopping and their position would vary with the intersection corner geometrics.

Figure 9


Bump-out lengths – existing (dashed) and desired lengths
Stopping sight distance (200' for 30 MPH)
Driver sits 10' behind travel lane edge and 3' off the centerline
Driver's desired sightline
Example Bump-out Length Measurement (NTS Diagram)

EDGELINE INSTALLATION CRITERIA

Edgelines are a desirable feature because they provide positive guidance to vehicular through traffic and narrow the perceived pavement width. They also delineate the separation from parking activity and encourage side street traffic to advance further into the major street where they have better sight distance. Edgelines can also be used to create space for bicycles and other users, emphasize areas where parking is illegal (either by use of tapered lines or delineating a shoulder too narrow for parking), and minimize unnecessary driving on paved shoulders or on refuge areas that have lesser structural pavement strength than the adjacent roadway.

I. MUTCD Guidelines

Specific edgeline guidance is provided in Section 3B.07 of the National MUTCD.

In rural areas, edgeline markings are **required** on uncurbed rural arterials with a traveled way of 20 feet or more in width and an ADT of 6,000 vehicles per day or greater, and are **recommended** on rural arterials and collectors with a traveled way of 20 feet or more in width and an ADT of 3,000 vehicles per day or greater. This recommendation should be considered as a requirement unless an engineering reason exists not to justify such.

In suburban and urban areas, as well as rural areas, edgelines should be used where an engineering study indicates a need for edgeline markings. They can be used whether or not a center line is marked. Since curbs help to delineate the edge of the pavement, edgelines are not necessary where curbs exist unless the curb lane is wider than 14 feet.

II. Width Considerations

The following should be considered when evaluating a potential edgeline candidate.

- Travel Lane Widths. While the minimum travel lane width is ten (10) feet, lane widths between eleven (11) feet and fourteen (14) feet are desirable. If eleven (11) foot lanes are not feasible, ten (10) foot lanes are an option (but not preferred).

- Parking Needs. An eight (8) foot offset of the edgeline off the curb is needed to provide a full width parking lane. If the pavement width is limited, a seven (7) foot shoulder area between the edgeline and the curb would allow enough room to pass parked vehicles. Since this offset is not as wide as a standard parking area, it is best suited for intermittent parking situations and should not be used when parking activity is expected to occur regularly.

- Bicycle Needs. A four (4) foot striped shoulder is the minimum width that can effectively be used by bicycles. A five (5) foot offset of the edgeline off the curb is needed to delineate a dedicated bicycle lane.

- Excess Pavement Width. Shoulders greater than eight (8) feet in width should be avoided because they may be perceived by motorists as a travel lane. When excess

pavement is to be marked out, consider increasing the width of the travel lanes and/or the median, or adding bike lanes, rather than marking a wide shoulder.

The following tables specify pavement marking treatments that apply for various directional widths with a single travel lane of various possible lane widths in each direction. There are separate tables for uncurbed and curbed roadways. Combinations indicated by "NA" indicate that the combination is either not possible or not normally used because better options are available for that width. Each cell in the table contains the pavement marking cross section options A to I available for the directional pavement width with the travel lane width.

Uncurbed Roadways

Pavement Marking Cross Section Options A-I								
A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
No Shoulder Or Edgeline	**Sharrow Marking**	**4' Or Less Striped Shoulder**	**5' Striped Shoulder**	**6' Striped Shoulder**	**7' Parking Lane**	**8' Parking Lane**	**7' Parking Lane + 5' Striped Shoulder**	**8' Parking Lane + 5' Striped Shoulder**

	Travel Lane Widths (feet)				
Directional Total Pavement Width	**10'**	**11'**	**12'**	**13'**	**14'**
10	A	NA	NA	NA	NA
11	C	A	NA	NA	NA
12	C	C	A	NA	NA
13	C	C	C	A	NA
14	C	C	C	C	A/B
15	D	C	C	C	B/C
16	E	D	C	C	B/C
17	F	E	D	C	B/C
18	G	F	E	D	B/C
19	NA	G	F	E	D
20	NA	NA	G	F	E
21	NA	NA	NA	G	B/F
22	H	NA	NA	NA	B/G
23	I	H	NA	NA	NA
24	NA	I	H	NA	NA
25	NA	NA	I	H	NA
26	NA	NA	NA	I	H
27	NA	NA	NA	NA	I

Curbed Roadways

Pavement Marking Cross Section Options A-I								
A	B	C	D	E	F	G	H	I
No Shoulder Or Edgeline	Sharrow Marking	4' Or Less Striped Shoulder	5' Striped Shoulder	6' Striped Shoulder	7' Parking Lane	8' Parking Lane	7' Parking Lane + 5' Striped Shoulder	8' Parking Lane + 5' Striped Shoulder

	Travel Lane Widths (feet)				
Directional Total Pavement Width	10'	11'	12'	13'	14'
10	A	NA	NA	NA	NA
11	A	A	NA	NA	NA
12	A	A	A	NA	NA
13	A	A	A	A	NA
14	C	A	A	A	A
15	D	C	A	A	A
16	E	D	C	A	A
17	F	E	D	C	A
18	G	F	E	D	C
19	NA	G	F	E	D
20	NA	NA	G	F	E
21	NA	NA	NA	G	F
22	H	NA	NA	NA	G
23	I	H	NA	NA	NA
24	NA	I	H	NA	NA
25	NA	NA	I	H	NA
26	NA	NA	NA	I	H
27	NA	NA	NA	NA	I

With curbing, edgelines are not needed for 13' directional lane widths or less since the curb helps delineate the edge

III. Exceptions

Where the MUTCD requirements for edgelines are not met edgeline markings may be excluded based on engineering judgment. Such as if the traveled way edges are delineated by curbs, parking, a bicycle lane marked on the outside portion of the traveled way, or other markings.

IV. Approvals

Within the City of Rochester, the City reimburses the County for all edgeline striping costs. Therefore, City review and approval is needed before adding new edgelines within the City.

FATAL ACCIDENT REVIEW

It is the policy of MCDOT to conduct a field review of the site of all fatal accidents that occur within Monroe County's jurisdiction, including within the City of Rochester. The procedure for these reviews is outlined as follows.

1. Conduct a preliminary field review of the site with pictures within two weeks of the date of the accident. This step is necessary because the police report for a fatal accident is often not available for 2-4 weeks. We do not to wait for the accident report because conditions may change over time. We want to document the conditions as soon as possible after the accident occurred.

2. Notify the appropriate personnel to address any damaged traffic control devices as a result of the accident and/or conditions that may have contributed to the accident.

3. Obtain the accident report from the police department.

4. Complete the form on the next page that summarizes specifics of the accident and site conditions.

5. Gather all relevant materials and route for review by the Division Head and MCDOT Director.

6. Follow through with any additional studies as per the review process and, if appropriate, make any recommendations for additional traffic control devices.

MONROE COUNTY DEPARTMENT OF TRANSPORTATION
FATAL ACCIDENT REPORT

Accident Date/Time_____ Report Date_____ Field Review Date_____

Location_____ City/Town_____

Direction of Travel	
Traffic Controls	
Traffic Signing	
Roadway Markings	
Speed Limit	
Roadway Alignment	
Roadway Profile	
Roadway Surface Condition	
Weather Conditions	
Illumination	
Summary of Events	

Reporting Official_____ Date_____

Section Head_____ Division Head_____ Dept. Head_____

HIGH ACCIDENT LOCATION PROGRAM (HALP)

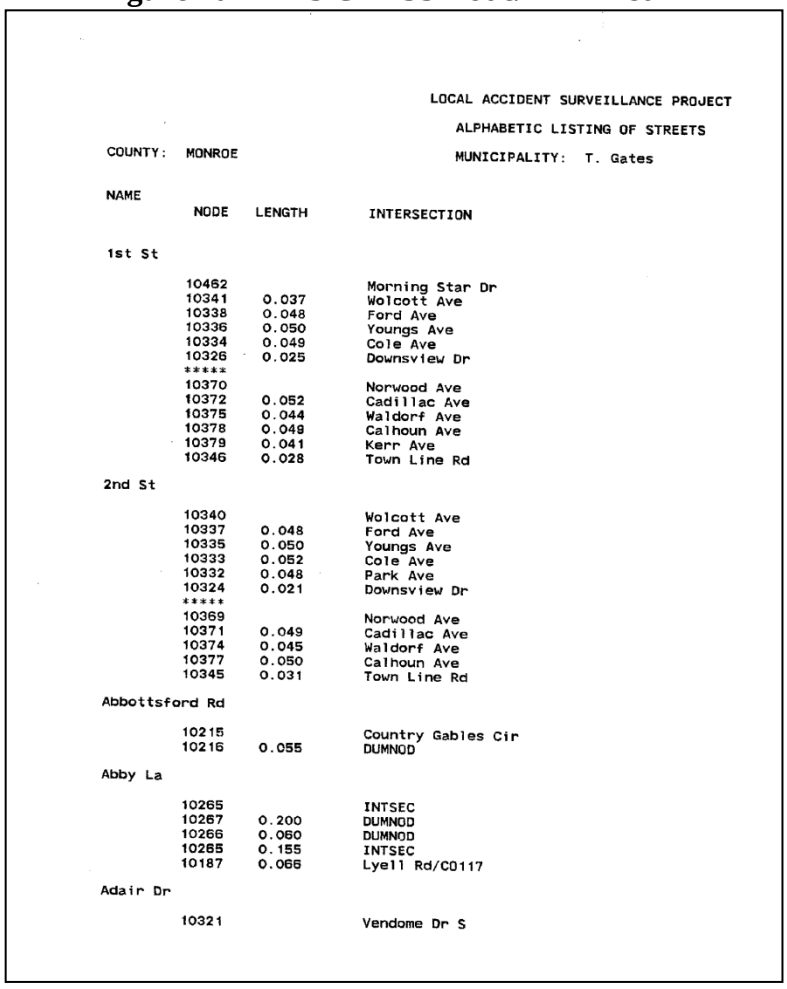
It is the policy of MCDOT to proactively identify intersection and non-intersection locations that have a higher than normal proportion of accidents compared to other facilities of similar type. This done via what is called the critical rate method developed by Northwestern University Traffic Institute, "Identification and Treatment of High Hazard Locations". High accident locations are identified and those chosen for review are designated as Priority Investigation Locations (PIL). An accident analysis study is conducted for each PIL to determine countermeasures to the accident patterns revealed.

Program Inputs

1. Annual statistics on numbers of accidents occurring at each location under MCDOT jurisdiction from the NYS Central Local Accident Surveillance System (CLASS)

Locations in CLASS are defined by a link/node system. There is a unique ID number for each node (intersection). Links (the linear section between two nodes) are defined by a combination of the two nodes that define them. CLASS provides annual numbers of accidents occurring at each node and within each link.

Figure 10 – NYS CLASS Node/Link List



LOCAL ACCIDENT SURVEILLANCE PROJECT

ALPHABETIC LISTING OF STREETS

COUNTY: MONROE MUNICIPALITY: T. Gates

NAME	NODE	LENGTH	INTERSECTION
1st St			
	10462		Morning Star Dr
	10341	0.037	Wolcott Ave
	10338	0.048	Ford Ave
	10336	0.050	Youngs Ave
	10334	0.049	Cole Ave
	10326	0.025	Downsview Dr
	*****		
	10370		Norwood Ave
	10372	0.052	Cadillac Ave
	10375	0.044	Waldorf Ave
	10378	0.049	Calhoun Ave
	10379	0.041	Kerr Ave
	10346	0.028	Town Line Rd
2nd St			
	10340		Wolcott Ave
	10337	0.048	Ford Ave
	10335	0.050	Youngs Ave
	10333	0.052	Cole Ave
	10332	0.048	Park Ave
	10324	0.021	Downsview Dr
	*****		
	10369		Norwood Ave
	10371	0.049	Cadillac Ave
	10374	0.045	Waldorf Ave
	10377	0.050	Calhoun Ave
	10345	0.031	Town Line Rd
Abbottsford Rd			
	10215		Country Gables Cir
	10216	0.055	DUMNOD
Abby La			
	10265		INTSEC
	10267	0.200	DUMNOD
	10266	0.060	DUMNOD
	10265	0.155	INTSEC
	10187	0.066	Lyell Rd/CO117
Adair Dr			
	10321		Vendome Dr S

2. Traffic Counts

a) Automatic Traffic Recorder (ATR) Program - periodically updates traffic count data on all County roads and arterial/major collector roads in the City. An outline of this program follows the discussion of the HALP.
b) ATR studies done by request or as part of in-house traffic studies
c) Intersection turning movement counts (TMC) done by request or as part of in-house traffic studies
d) ATR and TMC counts collected by consultants as part of traffic impact studies or regional traffic reviews

For the HALP, the main values used are Average Daily Traffic (ADT) for the links and Intersection ADT (IntADT) for nodes. The IntADT is the number of vehicles entering the intersection daily.

Program Outputs

1. Accident Rates

The accident rate (AR) is calculated for each link and node for which we have traffic count data (ATR and/or TMC counts). For nodes, the accident rate is in units of Accidents per 1 Million Entering Vehicles; for links, the rate is in units of Accidents per 1 Million Vehicle Miles. The formulas are as follows.

$AR(node) = [(\#acc/yr)(1x10^6)] / [(365 days/yr)(IntADT)]$
$AR(link) = [(\#acc/yr)(1x10^6)] / [(365 days/yr)(ADT)(length in miles)]$

2. Average Accident Rates

The link and node locations are grouped by functional class (plus by signalized and unsignalized control for nodes) and the accident rates are averaged for each group.

3. Critical Rates

The critical rate for each location is a function of the average rate and the traffic count. This value represents the accident rate threshold that if exceeded by the location rate, it is designated a high accident location.

$M(link) = [(ADT)(365)(length in miles)] / (1x10^6)$, in yearly Millions of veh-miles.

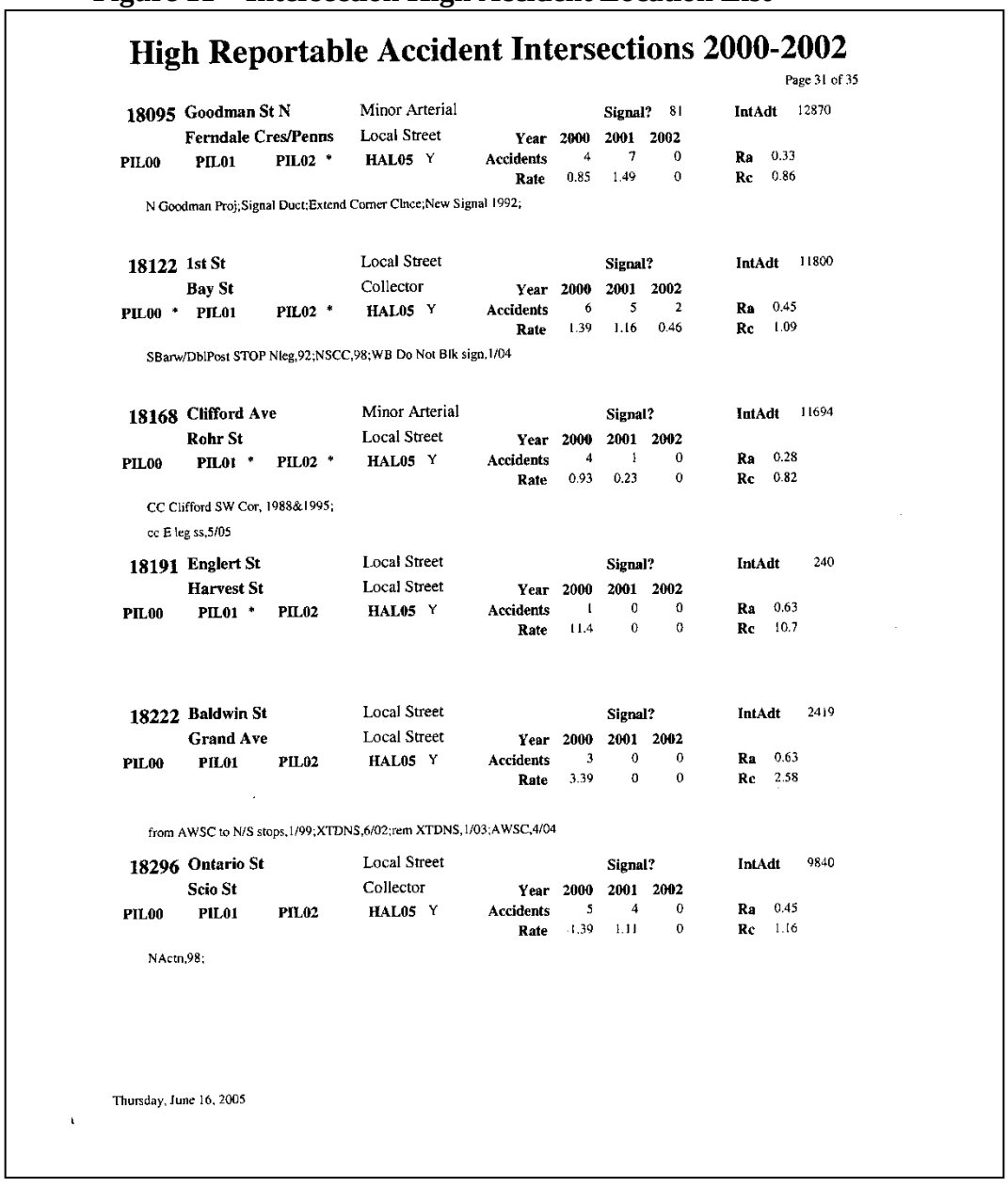
$M(node) = [(IntADT)(365)] / (1x10^6)$, in yearly Millions of entering vehicles.

$AR(critical) = AR(avg) + 1.645(\sqrt{[AR(avg)/M]}) + 1 / (2M)$

4. High Accident Location and PIL Lists

If the accident rate for a location exceeds the critical rate within any of the last three years, it is designated as a high accident location. The list of high accident locations is reviewed to determine which ones should be designated as PIL studies. What gets designated as a PIL is based on various factors. These include how many of the past three years are at or near the critical rate, when these occur, how the rates overall compare to the average, the number of accidents (number may be may be too small to come to significant findings), recent studies (or lack of) done at the location, recent changes to traffic control, road maintenance, and reconstruction done at the location, etc. The knowledge and experience of each reviewer is also a key asset when reviewing the high accident location list. Any location designated as a PIL is then studied in detail to determine possible causes and countermeasures.

Figure 11 – Intersection High Accident Location List



High Reportable Accident Intersections 2000-2002

Page 31 of 35

18095 **Goodman St N** — Minor Arterial — **Signal?** 81 — **IntAdt** 12870
Ferndale Cres/Penns — Local Street

					Year	2000	2001	2002		
PIL00	PIL01	PIL02 *	HAL05 Y		Accidents	4	7	0	Ra	0.33
					Rate	0.85	1.49	0	Rc	0.86

N Goodman Proj;Signal Duct:Extend Corner Clnce;New Signal 1992;

18122 **1st St** — Local Street — **Signal?** — **IntAdt** 11800
Bay St — Collector

					Year	2000	2001	2002		
PIL00 *	PIL01	PIL02 *	HAL05 Y		Accidents	6	5	2	Ra	0.45
					Rate	1.39	1.16	0.46	Rc	1.09

SBarw/DblPost STOP Nleg,92;NSCC,98;WB Do Not Blk sign,1/04

18168 **Clifford Ave** — Minor Arterial — **Signal?** — **IntAdt** 11694
Rohr St — Local Street

					Year	2000	2001	2002		
PIL00	PIL01 *	PIL02 *	HAL05 Y		Accidents	4	1	0	Ra	0.28
					Rate	0.93	0.23	0	Rc	0.82

CC Clifford SW Cor, 1988&1995;
cc E leg ss,5/05

18191 **Englert St** — Local Street — **Signal?** — **IntAdt** 240
Harvest St — Local Street

					Year	2000	2001	2002		
PIL00	PIL01 *	PIL02	HAL05 Y		Accidents	1	0	0	Ra	0.63
					Rate	11.4	0	0	Rc	10.7

18222 **Baldwin St** — Local Street — **Signal?** — **IntAdt** 2419
Grand Ave — Local Street

					Year	2000	2001	2002		
PIL00	PIL01	PIL02	HAL05 Y		Accidents	3	0	0	Ra	0.63
					Rate	3.39	0	0	Rc	2.58

from AWSC to N/S stops,1/99;XTDNS,6/02;rem XTDNS,1/03;AWSC,4/04

18296 **Ontario St** — Local Street — **Signal?** — **IntAdt** 9840
Scio St — Collector

					Year	2000	2001	2002		
PIL00	PIL01	PIL02	HAL05 Y		Accidents	5	4	0	Ra	0.45
					Rate	1.39	1.11	0	Rc	1.16

NActn,98;

Thursday, June 16, 2005

Figure 12 – Non-Intersection High Accident Location List

High Reportable Accident Segments 2000-2002

1 Buffalo Rd to Lyell Rd — 1.21 mi. — 11602 vpd — Suburban Local Road

Year:	2000	2001	2002
Accidents	4	9	4
Rate	0.781	1.7622	0.7832

Ra: 0.874
Rc: 1.652
HAL 00-02 Y

No Action 1989-90;

Greece

Dewey Ave

1 Latta Rd to LOSP ramp — 0.54 mi. — 8269 vpd — Suburban Arterial

Year:	2000	2001	2002
Accidents	5	1	2
Rate	3.071	0.6158	1.2317

Ra: 1.094
Rc: 2.752
HAL 00-02 Y

Dewey CIP 93;

5 English Rd to Dorsey Rd — 0.49 mi. — 20624 vpd — Suburban Arterial

Year:	2000	2001	2002
Accidents	5	9	5
Rate	1.349	2.435	1.3528

Ra: 1.094
Rc: 2.124
HAL 00-02 Y

Dewey CIP 93;

7 Stone Rd to bndary — 0.37 mi. — 17673 vpd — Suburban Arterial

Year:	2000	2001	2002
Accidents	4	4	6
Rate	1.653	1.6580	2.4870

Ra: 1.094
Rc: 2.409
HAL 00-02 Y

Fetzner Rd

1 Maiden Lane to Ridge Rd — 1.16 mi. — 12705 vpd — Suburban Local Road

Year:	2000	2001	2002
Accidents	14	5	7
Rate	2.6	0.9311	1.3035

Ra: 0.874
Rc: 1.631
HAL 00-02 Y

No Action 1990;

Island Cottage Rd

Wednesday, July 06, 2005

TRAFFIC SIGN REFLECTIVE SHEETING POLICY

Signs are fabricated with a choice of sheeting. Some of this sheeting is specifically designed to reflect light back to the driver at a higher intensity level. This is particularly beneficial when the sign has to stand out prominently at night and/or compete against a bright and/or visually complex background. Therefore, this material can help to improve the night visibility of certain signs that need extra attention. It should be used only when necessary; overuse would also diminish its effectiveness. The other materials used provide night visibility at a lower level, but can still be readily seen at night.

REFLECTIVE SHEETING USE:

- Type I (Engineering Grade) – PARKING SIGNS ONLY (UNTIL 2018)

- Type III (High Intensity Prismatic) - All other signs, unless superseded by our existing policy concerning use of Diamond grade material.

- Type IX (Diamond grade cubed - DG³) to be used as determined in our existing policy for Diamond grade VIP.

Fluorescent Yellow Green colored sheeting shall be used for all school crossing signs. Yellow sheeting is still standard for non-school crossings but Fluorescent Yellow Green and Fluorescent Yellow are options.

Existing stocks of material will be used before purchasing new material (SNS, regulatory and warning signs can continue to be made as in the past, until stocks of material is depleted).

Diamond grade cubed - DG³ (or equal) shall be used for the following traffic signs. All other traffic signs not covered below shall be fabricated with minimum reflective sheeting.

- All overhead signs
- All regulatory and warning signs located on the left side of the roadway (to oncoming traffic) the exception to this would be for: "one ways", "no outlets", and "dead ends" where street lighting exists
- All regulatory and warning signs except parking signs located in areas with high levels of background competing lights (i.e. - billboards, building lighting, commercial signs)
- Chevron curve warning signs. (W1-8L and W1-8R)
- All regulatory and warning signs at an acute angle to oncoming headlights, (mostly applicable at intersections)
- Locations where an accident study has identified patterns of accidents indicate additional nighttime sign visibility is needed

HIGHWAY LIGHTING POLICY

POLICY:

The following guidelines will be used to evaluate requests for lighting County roads. They are also used for NYS arterial highways.

Any one of the following conditions shall be considered as warranting the installation of lighting by others and maintenance of lighting at County expense.

1. Continuous or partial lighting is considered warranted on those sections of a non-controlled access highway where the ratio of night-to-day accident rates is at least 3.0 and where the total accident rate is at least 2 times greater than the statewide average for similar facility types, provided an average of 6 or more night accidents per mile per year or l night accident per spot location per year have occurred on the section over a 3-year period.

2. Lighting is considered warranted at intersections where for a period of any 4 nighttime hours, a minimum pedestrian volume of 400 pedestrians per intersection area and 600 entering vehicles (all approaches) is encountered during the 4-hour period. Where the 85th percentile speed of artery traffic exceeds 40 miles per hour these warrants are reduced by 25%.

When the warrants for lighting are not met, we call the town, apprise them of our findings, and inquire if they would wish to install lighting at their expense. If so, we include them in our response and provide approval for them to install, maintain, etc. the necessary lighting. Otherwise, we would write directly back to the requestor and identify that the lighting is not justified.

The NYSDOT also has a policy for installation of lighting on expressways. Although it is primarily a NYSDOT decision, MCDOT does have a role in reviewing where expressway lighting goes, due to the fact that the county maintains the expressway lighting system. NYSDOT guidelines recommend continuous lighting along expressway lighting sections when the lighting from adjacent interchanges are less than one-half mile (2,640 feet) apart, and when the traffic volume exceeds 75,000 vehicles per day. Other conditions such as high night-to-day accident rates may apply as well. For more information, see the NYSDOT Highway Lighting Warrants for State Highways.

INTERSECTION WARNING SIGNS

Policy

The principal consideration in determining if an intersection sign is justified is the distance for which the intersection is visible to approaching traffic. However, accident experience and other factors, such as unusual geometrics, are also important considerations.

Since the National MUTCD is very general as to what conditions justify an intersection ahead sign, the enclosed figure (formerly Figure 232.1 from the 2003 NYSMUTCD) should be used as a guide

to intersection sign determinations. It expresses the significance of intersection visibility in terms of sight distance along the roadway and eighty-fifth percentile approach speed.

Guidelines

All requests for intersection signs on City or County roads shall be in compliance with the enclosed figure (formerly Figure 232.1 from the 2003 NYSMUTCD), proceeding with one or more of the following studies.

1. Field Review

   A field review to determine sight distance of a vehicle entering the major street from each minor approach, viewing to the left and right. Unusual conditions that may affect the justification of an intersection sign in compliance with the Manual of Uniform Traffic Control Devices should be reviewed and noted.

2. Speed Study

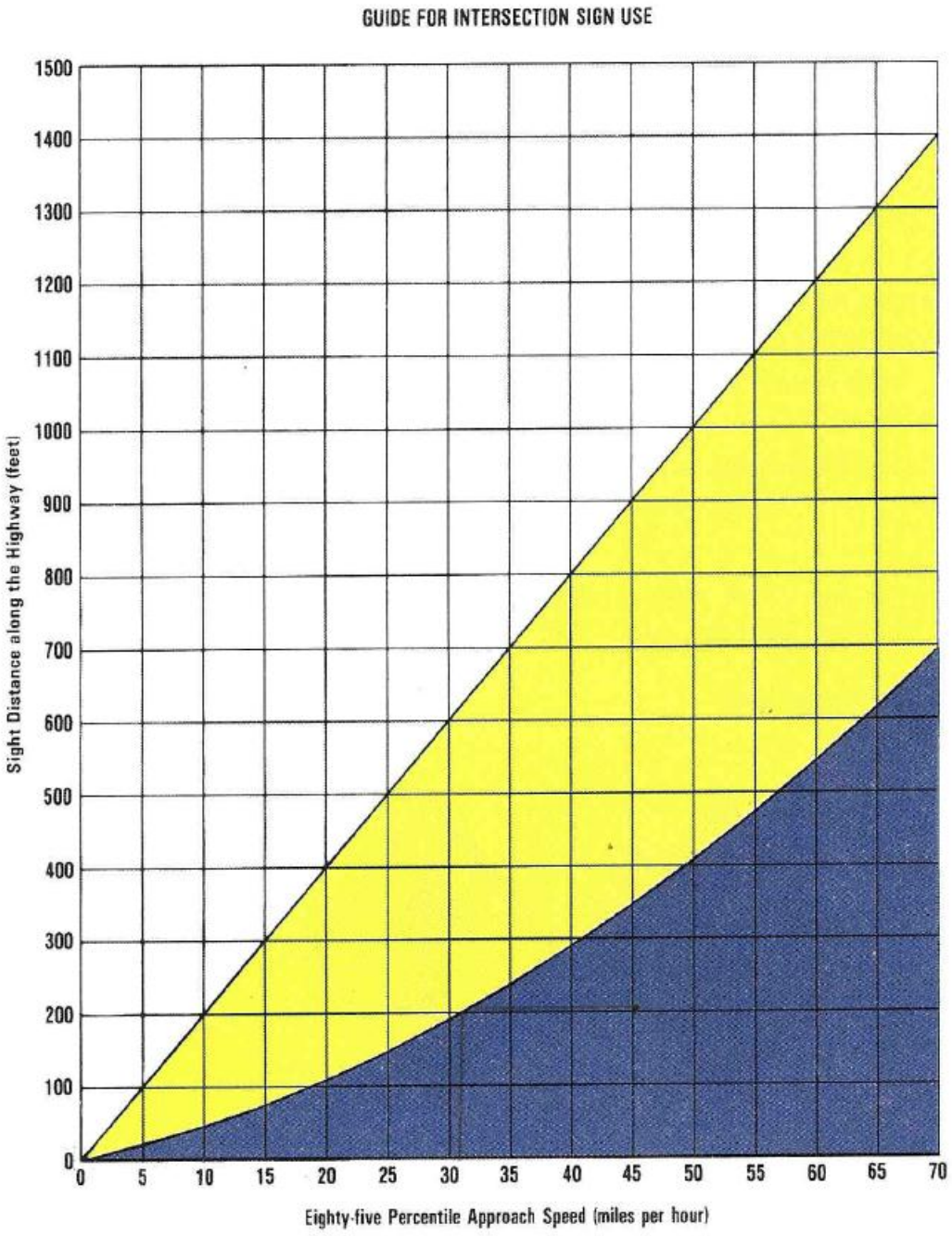
   A speed study through the use of machine counters or radar units may be done to determine 85th percentile approach speeds on the major street if a reasonable estimate of operating speed cannot be determined by flowing with traffic.

3. Accident Experience

   The accident history may reveal accident types correctable by intersection warning signs.

Figure 13 – 2003 NYSMUTCD Figure 232.1

FIGURE 232-1
GUIDE FOR INTERSECTION SIGN USE



Justification

Appropriate action, depending on where a plotted point on Figure 232.1 falls, is determined as follows.

1. White Area

   Except where unusual conditions require otherwise, an intersection sign should not be used.

2. Yellow Area

   This indicates less than desirable sight distance but not critically limited. An intersection sign is not usually necessary unless other factors indicate a need.

3. Blue Area

   This indicates critically limited sight distance and an intersection sign should be used.

If a plotted point falls in the blue area, an advisory speed can be posted. To determine the appropriate advisory speed, trace a line parallel with the horizontal axis from the plotted point back to the point where the yellow and blue areas meet. The approach speed corresponding to the point on the line where the yellow and blue areas meet is the appropriate advisory speed.

MULTILANE CONVERSION OR "ROAD DIETS"

It is the policy of MCDOT to review the appropriate traffic lane cross sections of City and County corridors and intersection approaches when there is a road maintenance or reconstruction opportunity to change them if needed. This not only includes looking for needed capacity improvements, but also looking for opportunities to shift the use of available pavement width from vehicular travel lanes to auxiliary features such as right or left turn lanes, bicycle lanes, shoulders, "bump-outs", and medians. Bump-outs are curb extensions midblock or at the corners of intersections that create recessed areas for parking, bus stops, and other areas not part of the through travel lanes.

Potential Benefits of Multilane Conversion

1. Creation of vehicular safety features such as left turn lanes, shoulders, and medians

2. Provides traffic calming by reducing prevailing speeds of through traffic

3. Makes the roadway more multi-modal through the creation of safety features for non-vehicular traffic such as bicycle lanes, "bump-outs", narrower pedestrian crossings, and pedestrian medians. For pedestrians, it also eliminates "multiple threat" conflicts at crosswalks.

4. Creation of on-street parking that benefits residential and commercial development, and reduces the speed of through traffic

5. Creation of recessed parking and/or edgelines to separate parking from through traffic

6. Provides opportunities for community gateway beautification through landscaping

7. All the above improves the livability of the community at large

Criteria for Consideration

All of the following should be met for the location to be a candidate.

1. Having more than one travel lane in one or both directions
2. Peak one-way traffic volume of less than 450 vehicles per hour per travel lane
3. The capacity of intersections should not be compromised
4. The potential conversion should minimize the impact to available parking. Some designs may require the elimination of all on-street parking

In evaluating candidates, lane continuity and adequate transition areas need to be considered. The potential safety benefit (reduction of accident rates or identification of correctable accident patterns) should also be considered, but since the benefits extend beyond safety, a conversion can be done even if the accident rate is already low.

Other Lesser Conversion Measures

All of the measures listed below are also traffic calming features that will likely reduce prevailing vehicular speeds.

1. Isolated left turn and/or right turn pockets at intersections and/or driveways

These are safety features that address left turn, sideswipe, and rear-end type accident patterns by moving turning traffic out of the travel lane. However, their creation in lieu of through lanes should not compromise intersection capacity. When possible, try to avoid creating lane drops approaching the location.

2. "Bump-outs" (Also see section “Curb Extensions”)

These features improve safety by narrowing pedestrian crossings (thus reducing their exposure, creating more available gaps in two-way traffic for crossing) and creating recessed parking areas. However, bump-outs should usually be used as a linear treatment so that they do not become an unexpected hazard to vehicular traffic. They may be used at isolated intersections but should not normally be used at isolated midblock locations. Bump-outs can be created by striping, but are more effective if done by curbing or other physical means.

3. Pedestrian Medians

These are raised pedestrian shelters in the middle of the roadway. They are in some ways superior to bump-outs as a pedestrian safety feature. They narrow the distance the pedestrian must cross, as do bump-outs. In addition, they also allow the pedestrian to accept two separate one-way gaps in traffic when a two-way gap is not available. One-way gaps are far more plentiful than two-way gaps, and thus medians can be used to create safer pedestrian crossings on much busier roads than can bump-outs. Also, when looking for a one-way gap, the threat comes from one direction only rather than from two directions when looking for a two-way gap. We would not recommend implementing these with striping only, as the pedestrian would not be physically protected.

Some disadvantages of medians are that they must be very well designed and delineated so they do not become a hazard to through and/or turning traffic, there is often limited space on the median for large groups of pedestrians, they can be more of a hazard to plow operations than bump-outs, and, if not very well maintained, they may become an eyesore.

OBJECT MARKER GUIDELINES

1) W7-12C and W7-13C (barber poles)

These are recommended to be installed at all fixed objects (culvert headwalls, bridge abutments, etc. including those with guiderail) immediately adjacent to the shoulder or that are 8′ or less from the edge of pavement. Installation of these markers is as follows.

A) Where the object height is greater or equal to 16 inches, the markers should be installed at all four (4) approaches.

B) Where the object height is less than 16 inches these markers should be installed at the two (2) leading approaches.

2) W7-11C or safe hit object markers (yellow reflective sheeting - 3″x 9″ & yellow tubing)

These signs are recommended for use at locations where guiderail is not recommended, but the technician/engineer believes some form of warning/guidance is needed. Recommended locations are drop offs immediately adjacent to the roadway or shoulder at spacing to be determined by field conditions.

3) Safe hit object markers (white reflective sheeting - 3″x 9″)

White reflectorized safe hits can be used for delineation in conjunction with other warning signs through horizontal curves, etc. to provide additional guidance and direction (on both sides of the road, if need be).

RIGHT-OF-WAY CONTROL POLICY - PRIVATE ROADS & DRIVEWAYS ON CITY OR COUNTY ROADS

Private Roads: (definition: any undedicated roadway that has addresses assigned to it)

- Any private roadway that intersects a county road shall have right-of-way control designated by MCDOT.
- Stop signs on private roads that intersect a county road or city street shall be installed and maintained by MCDOT. Any additional traffic control devices deemed necessary by MCDOT and approved by town/city regulation or ordinance shall also be maintained and installed as stated above. Signs deemed necessary by the owner (i.e., "one way", "no outlet", "dead end") shall not be maintained by MCDOT.
- Upon request and for a one-time fee of $250, street name signs will be installed and maintained by MCDOT.

Driveways:*

- Stop signs at driveways intersecting a county road or city street shall be installed and maintained by the property owner. Signs should be outside of the right-of-way if possible; however, if not feasible, MCDOT will allow the installation in our right-of-way with a permit.[1]
- Any stop signs previously installed at driveways by MCDOT shall no longer be maintained by MCDOT.
- Turn restrictions type signs (i.e. "no left/right turn", "do not enter", "one way") deemed necessary by MCDOT and approved by town/city ordinance or regulation shall be maintained by MCDOT.

[1]Exceptions: If we determine that an accident problem at a driveway exists, and a stop sign is necessary, the owner will be directed to install a stop sign. If the owner does not install the stop sign in a timely fashion (60 days), MCDOT will install one and charge back the owner. The owner will then be responsible for maintenance of the stop sign.

*New York State Vehicle and Traffic Law, Section 1143:

> "**Vehicle entering roadway.** The driver of a vehicle about to enter or cross a roadway from any place other than another roadway shall yield the right-of-way to all vehicles approaching on the roadway to be entered to crossed."

Public Town Roads That Intersect County Roads

MCDOT shall install and maintain stop signs and street name signs. Any other traffic control devices deemed necessary by MCDOT and approved by town regulation or ordinance shall also be installed and maintained by MCDOT. Traffic control devices deemed necessary by the town (i.e., "one way", dead end", "no outlet") shall be maintained by the town.

SCHOOL ZONE SIGNS, CROSSING GUARDS, AND FLASHING BEACONS

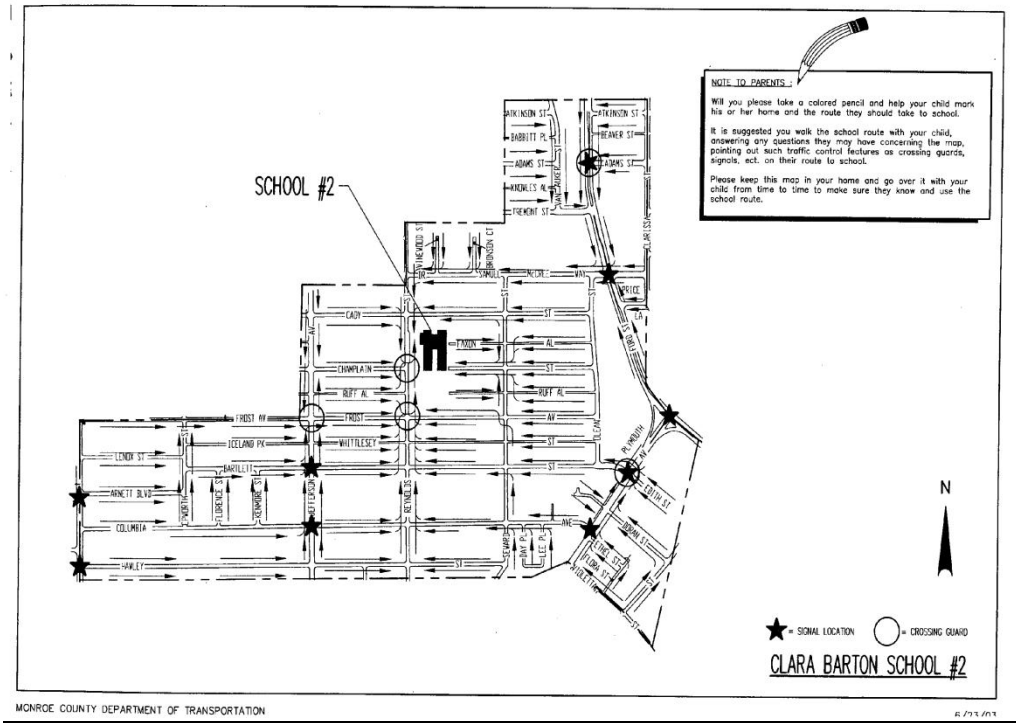
Policy

As per its role as a member of the School Traffic Safety Committee for the City of Rochester, and as the custodian of County highways outside the City, it shall be the policy of the MCDOT to study and review all school zones to ensure they are adequately marked for approaching motorists, and that all designated school pedestrian crossings within the zones are also adequately marked and supervised if needed. A school zone is defined as a zone containing a designated school crossing with uncontrolled approaches, a supervised school crossing, or the area directly adjacent to the school building.

Safe School Route Maps

The subject devices will also be located and designed to enhance the safety of and encourage use of the designated school walking routes in the Safe School Route Maps. These are maps of school pedestrian feeder patterns for City of Rochester public and parochial elementary and middle schools having a grade of six or below. Charter Schools are to have maps developed by their traffic consultant and approved by MCDOT as part of their site plan approval if significant walking traffic is expected. These feeder patterns are designed based on the most efficient walking path that takes best advantage of the existing traffic control devices. The information on the maps includes district boundaries, street centerlines, location of the school, arrows designating the walking routes, traffic signals, and crossing guards. The School Traffic Safety Committee and the MCDOT Design Unit jointly maintain these maps (except for Charter Schools).

Figure 14 – Safe School Route Map



Revised December 24, 2008

The Rochester City School District has a "Schools of Choice" program where students who live in one district can attend school in another district. If the districts are adjacent, the student may still live within 1.5 miles of the chosen school and therefore would not qualify for busing. In these cases, the need to designate safe routes to school would expand across district boundaries. Special maps and accommodations (such as marked school crossings and/or crossing guards) may be needed. These are best handled on a case by case basis, with consideration given to the dynamic nature of these walking patterns.

School Speed Limits

A school speed limit shall be established only if all of the following conditions exist.

1. The school has one or more grades below grade 12; or a licensed child care facility provided in an institutional setting.
2. Some of the child walk/bicycle to/from the facility; or the facility and supporting facilities are separated by a highway, and require that the children cross the highway on foot to access the facilities.
3. The facility and the jurisdiction responsible for the highway provide written documentation of their support for a school speed limit.

AND all the following conditions should be met.

1. The zone contains a marked crosswalk that is a designated school crossing
2. The crosswalk is supervised by a crossing guard
3. There is no nearby traffic control signal or stop controlled intersection approach suitable for pedestrian use

The school speed limit should be set no more than 10 MPH below the prevailing 85^{th} percentile speed on the highway or the 85^{th} percentile speed within the school zone during school crossing periods. The school speed limit should only be in effect up to 30 minutes before and after periods of school vehicular/pedestrian activity within the core hours of 7 AM through 6 PM. These times must be conveyed to the driver by either a supplemental panel or timed flashing beacons with "When Flashing" panels on the school speed limit signs. If the flashers are on too often, their effectiveness is reduced and non-compliance will tend to occur.

School Crossing Warning Signs

These signs should be used only at designated school pedestrian crossings that have either uncontrolled approaches, or on signalized approaches that are supervised by a crossing guard. They are not normally used on stop controlled approaches to designated school crossings.

Advance School Pedestrian Warning Signs

These signs are posted in advance of designated school crossings that are marked with a crosswalk and school crossing warning signs, and have uncontrolled approaches. They are not normally posted in advance of signal controlled crossings. They are also posted to warn motorists that they are approaching a school zone unless the motorists would first encounter a traffic control device requiring a stop before entering the zone, and the school building is visible.

This manual defines a school zone as adjacent to a place of learning that is consistent with the definition in Section 7B.11 of the New York State Supplement to the MUTCD **AND** has students who walk to school, has outdoor facilities that would place students in close proximity to the road, or has facilities on both sides of the road that require a crossing of the road to go between them.

Flashing Beacons on Advance School Crossing Warning Signs

This device was first developed as an alternative to school speed limits. The beacons flash only during periods of school activity to warn the motorists of this activity and to be more cautious.

Conditions that may warrant the installation of flashing beacons on the advance school pedestrian warning signs include.

1. The flashing beacons encompass a marked, supervised crossing. Or the roadway is on the safe school route and exhibits school traffic safety problems.

2. Speed analysis conducted during the school's arrival and dismissal period identifies abuse of the 30 MPH City speed limit (85th percentile speed is 35 MPH or higher)

3. The school is an elementary or junior high school

MCDOT uses the following 2-15 point scoring system to evaluate the need for flashers and the priority given to a location when multiple locations are being considered for flashers.

1. Traffic Volumes

< 1200 veh per day	1 point
1201 – 4000 veh per day	3 points
> 4000 veh per day	5 points

2. Pedestrian Volumes (total for AM + PM periods)

< 40	1 point
41 – 80	3 points
> 81	5 points

3. Miscellaneous Conditions

    a. High speed – 85th % speed at least 35 MPH
    b. School building not visible
    c. Existing school traffic controls – such as a marked crossing or a crossing guard

None of the conditions above exist	0 points
One of the conditions exist	1 point
Two of the conditions exist	3 points
Three of the conditions exist	5 points

Total all the points scored. A total of 11 or more indicates that flashers should be considered.

SIGHT DISTANCE

MONROE COUNTY DEPARTMENT OF TRANSPORTATION
PROCEDURES FOR DETERMINING INTERSECTION SIGHT DISTANCE
REVISED JUNE 2006

Introduction

The following are procedures for measuring intersection sight distance as established by Monroe County DOT for its engineers and technicians. Evaluation of the adequacy of intersection sight distance is based on the 2004 AASHTO Green Book. All referenced exhibits are at the end of this document.

Terms

Intersection Sight Distance	Sight distance provided at intersections to allow drivers without the right of way to cross/enter the roadway and avoid conflicts without significantly affecting traffic operations.
Major Road (Through Road)	Road without the stop or yield controls.
Minor Road (Side Road/Driveway)	Road with the controlled approaches at a stop or yield controlled intersection.
Clear Sight Triangle	Specified areas along intersection approach legs, and across their included corners, that should be clear of obstructions that might block a driver's view of potentially conflicting vehicles.
a (See Exhibit 9-50)	Length of the clear sight triangle along the side road/driveway. This is defined as 14.5' behind the edge of the major road travel lane on stop controlled approaches (approximate location of the driver's eye).
b (See Exhibit 9-50)	Length of the clear sight triangle along the major road. Note that in Exhibit 9-50, it stops at the center of the side road/driveway.

Identification of Clear Sight Triangles

Design Vehicles

Passenger Car	Assume that the driver's eye is ±3' 6" above the roadway surface and that the object to be seen is ±3' 6" above the surface of the intersecting road.
Truck	The recommended value of truck driver eye height is ±7' 8" above the roadway surface and the object to be seen is ±3' 6" above the surface of the intersecting road.

Sometimes it is appropriate to determine clear sight triangles for both passenger cars and trucks. In these cases, the smaller clear sight triangle should be used, i.e. - lower value of b as per Exhibit 9-50.

Field Procedures

The first step is to set the appropriate length **a**, as per Exhibit 9-50, to be 14.5' behind the edge of the major road travel lane. The edge of the major road travel lane can be defined by a curbline extension, a white edgeline, or edge of pavement if neither exists. The determination of b, as per Exhibit 9-50, varies as follows.

One Person	Place a delineator of the appropriate height for the assumed design vehicle 14.5 feet (**a**) behind the edge of the major road travel lane. In your vehicle, slowly approach the intersection from the left and right along the major road. Maintain 3' 6" as the height of your eyes above the roadway surface. Measure from the point where you begin to see the top of the delineator to the center of the side road/driveway travel lane. It is helpful to mark within your vehicle where 3' 6" above the roadway surface falls. If the design vehicle is a truck, it is recommended to have 2 vehicles or a truck present so the special delineator can be set up to achieve the required 7' 8" height.
Two Persons	Each person's vehicle should have a two-way radio. Place one person in a vehicle whose eyes are 14.5 feet (**a**) behind the edge of the major road travel lane and at the appropriate height for the assumed design vehicle. The second person should then approach from the left and right as in the one-person procedure. Except now, a two-way radio link between the stationary and moving vehicle can establish when each driver sees the other individual or sees the appropriate place on the windshield that is 3' 6" above the pavement. At this point in time, the distance to the center of the side road/driveway can be measured as in the one-person procedure.

Types of Controls or Movements

Stop Control on the Side Road/Driveway

Clear departure sight triangles, as shown in Exhibit 9-50B, should be considered for left turns and right turns from the side road/driveway. In most cases, it can be assumed that the clear departure sight triangles for left and right turns onto the major road will also provide more than adequate sight distance for side road/driveway vehicles to cross the major road. Where design speed is referred to, use the 85% speed where it is known or can be estimated. If the 85th percentile speed is not known or not easily determined, use the speed limit plus five (5) MPH.

1. Determine 85% speeds on the major road approaching the intersection.

2. For a two lane major road and a side road approach grade of less than 3 %, use the table on page six or the graph line for the appropriate design vehicle (PC, SU, or COMB) on Exhibit 9-56 to determine the minimum required intersection sight distance (side **b** of the clear sight triangle in Exhibit 9-50B) for entering the major road. If the major road is more than two lanes and/or the side road approach grade is more than 3 %, you must use Equation (9-1) and Exhibit 9-54 to determine the minimum required intersection sight distance required.

3. Set **a** = 14.5', as per Exhibit 9-50B, and use the Field Procedures to measure the actual intersection sight distance (**b** in Exhibit 9-50B). Compare the actual **b** to the required **b** ascertained from Exhibit 9-56 or Equation (9-1).

The value given to **a** of 14.5' from the edge of the major road travel lane represents the typical position of the side road/driveway driver's eye when a vehicle is stopped relatively close to the major road.

Determination of Adequate Sight Distance

Compare measured sight distance to the minimum required sight distance ascertained from the above procedure. If the measured sight distance meets or exceeds the minimum required sight distance, sight distance is adequate as is. If a changeable condition were causing a sight distance restriction (foliage, parking, etc.), then we would seek to rectify the problem. If the sight distance restriction is not changeable (vertical/horizontal curve, building, etc.), then use the MUTCD procedure to determine if a warning sign is needed.

For permit inspectors, proposed accesses should be located so that they meet intersection sight distance requirements. Where there is no available location with adequate intersection sight distance along the frontage, the access shall be located such that sight distance is optimized in each direction and the location should be checked to see if stopping sight distance requirements (from the table on page six or the line labeled SSD on Exhibit 9-56) can be met. **Note: stopping sight**

distance is calculated differently from intersection sight distance. If the stopping sight distance is adequate, but intersection sight distance is less than the AASHTO minimum, we would approve the access and, if needed, install driveway warning signs as per MCDOT policy on use of these

signs. If both intersection and stopping sight distance are less than required, we will recommend to the town that the access be denied due to inadequate sight distance.

Traffic Signal Control

At signalized intersections, the following criterion applies.

- If the signal is placed on red/amber flashing operation during off-peak or nighttime periods, then appropriate clear sight triangles for stop control on the side road/driveway should be provided.

- If right turns on a red signal are permitted at any time of the day from any approach, the sight distance required for those making the right turn looking to the left is guided by Figure 232.1 in the NYSMUTCD. A point that falls within the blue area on the graph indicates inadequate sight distance for right turns on red to be allowed.

All Way Stop Control

The first stopped vehicle on each approach should be visible to the driver of the first stopped vehicle on each of the other approaches.

Left Turns from a Major Road

All locations along a major highway from which vehicles are permitted to turn left across opposing traffic, including at-grade intersections and driveways, should have sufficient sight distance for drivers to decide if it is safe to turn left across the lane(s) used by opposing traffic. If adequate sight distance for stop control has been provided for each side road/driveway approach, sight distance will generally be adequate for left turns from the major road and no separate check is needed. However, at three-leg intersections or driveways located on or near a horizontal curve on the major road, the sight distance for left turns onto the side road/driveway should be checked. Also, sight distance for left turns from divided highways should be checked because of possible sight obstructions in the median.

1. Determine the 85% speed of traffic on the major road (V_{major}) opposing the left turning vehicle. If the 85% speed is unknown or not easily determined, use the speed limit plus five (5) MPH.

2. If the left turning vehicle crosses one opposing lane, use the table on page six or the graph line for the appropriate design vehicle on Exhibit 9-68 to determine the minimum required sight distance for the design speed of opposing traffic. If more than one opposing lane is crossed, use Exhibit 9-66 to calculate the required sight distance. The sight distance along the major road required to accommodate left turns is the distance traversed at the design speed of the major road in the travel time for the design vehicle given in Exhibit 9-66.

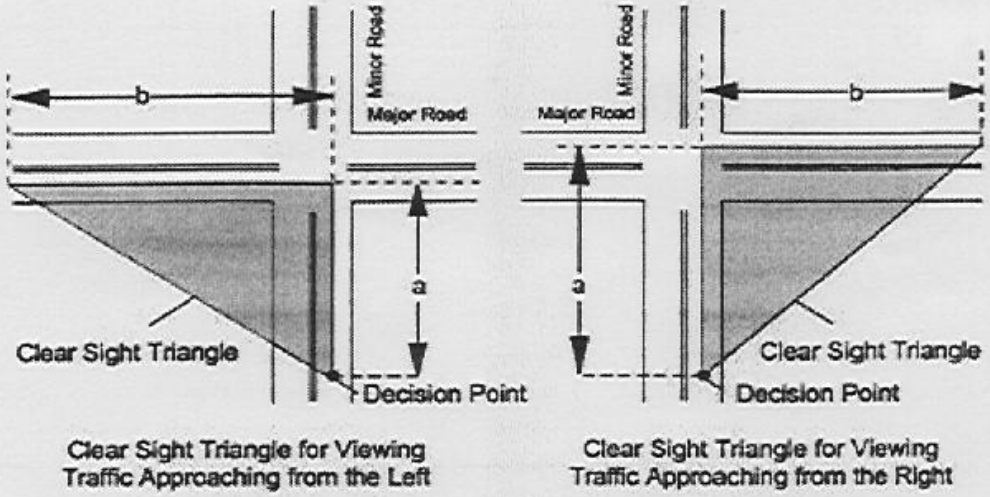
3. To measure the actual sight distance available for left turning vehicles, place the delineator at the point where the driver would likely be sitting when making a left turn from the major road. Approach the intersection in the opposing lane(s) and start measuring the sight distance along the major road when you can see the top of the delineator. Stop the measurement when you come to the first likely conflict point between a left turner and opposing traffic. This measured distance is the available sight distance for left turning vehicles. If there is more than one opposing lane, use the least sight distance measured.

Table of Commonly Used AASHTO Minimum Required Sight Distances

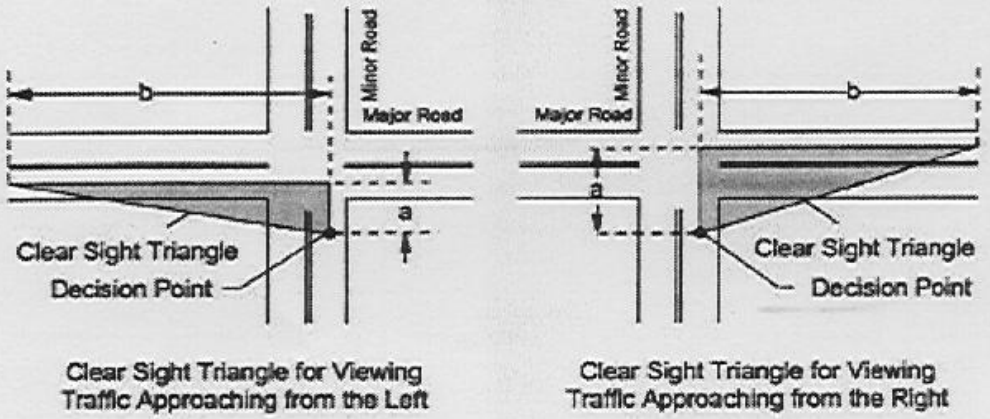
The values in Table V that follows applies to passenger cars crossing only one lane on major and minor street approaches that have grades between -3 % and +3 %. This is the most common case reviewed. If reviewing other cases (ie - trucks and/or steeper grades and/or LT's crossing multiple lanes), use the equations and/or graphs in Exhibits 9-54 to 9-68.

Table V

Design Speed (MPH)	Stopping S.D. (ft)	Int. S.D. (LT fr.stop) (ft)	LT fr. Major Road S.D. (ft)
15	80	170	125
20	115	225	165
25	155	280	205
30	200	335	245
35	250	390	285
40	305	445	325
45	360	500	365
50	425	555	405
55	495	610	445
60	570	665	490
65	645	720	530
70	730	775	570
75	820	830	610
80	910	885	650



A – Approach Sight Triangles



B – Departure Sight Triangles

Exhibit 9-50. Intersection Sight Triangles

Metric	US Customary
$ISD = 0.278\, V_{major}\, t_g$	$ISD = 1.47\, V_{major}\, t_g$ (9-1)
where: ISD = intersection sight distance (length of the leg of sight triangle along the major road) (m) V_{major} = design speed of major road (km/h) t_g = time gap for minor road vehicle to enter the major road (s)	where: ISD = intersection sight distance (length of the leg of sight triangle along the major road) (ft) V_{major} = design speed of major road (mph) t_g = time gap for minor road vehicle to enter the major road (s)

Design vehicle	Time gap (s) at design speed of major road (t_g)
Passenger car	7.5
Single-unit truck	9.5
Combination truck	11.5

Note: Time gaps are for a stopped vehicle to turn right or left onto a two-lane highway with no median and grades 3 percent or less. The table values require adjustment as follows:

For multilane highways:

For left turns onto two-way highways with more than two lanes, add 0.5 seconds for passenger cars or 0.7 seconds for trucks for each additional lane, from the left, in excess of one, to be crossed by the turning vehicle.

For minor road approach grades:

If the approach grade is an upgrade that exceeds 3 percent; add 0.2 seconds for each percent grade for left turns

Exhibit 9-54. Time Gap for Case B1—Left Turn from Stop

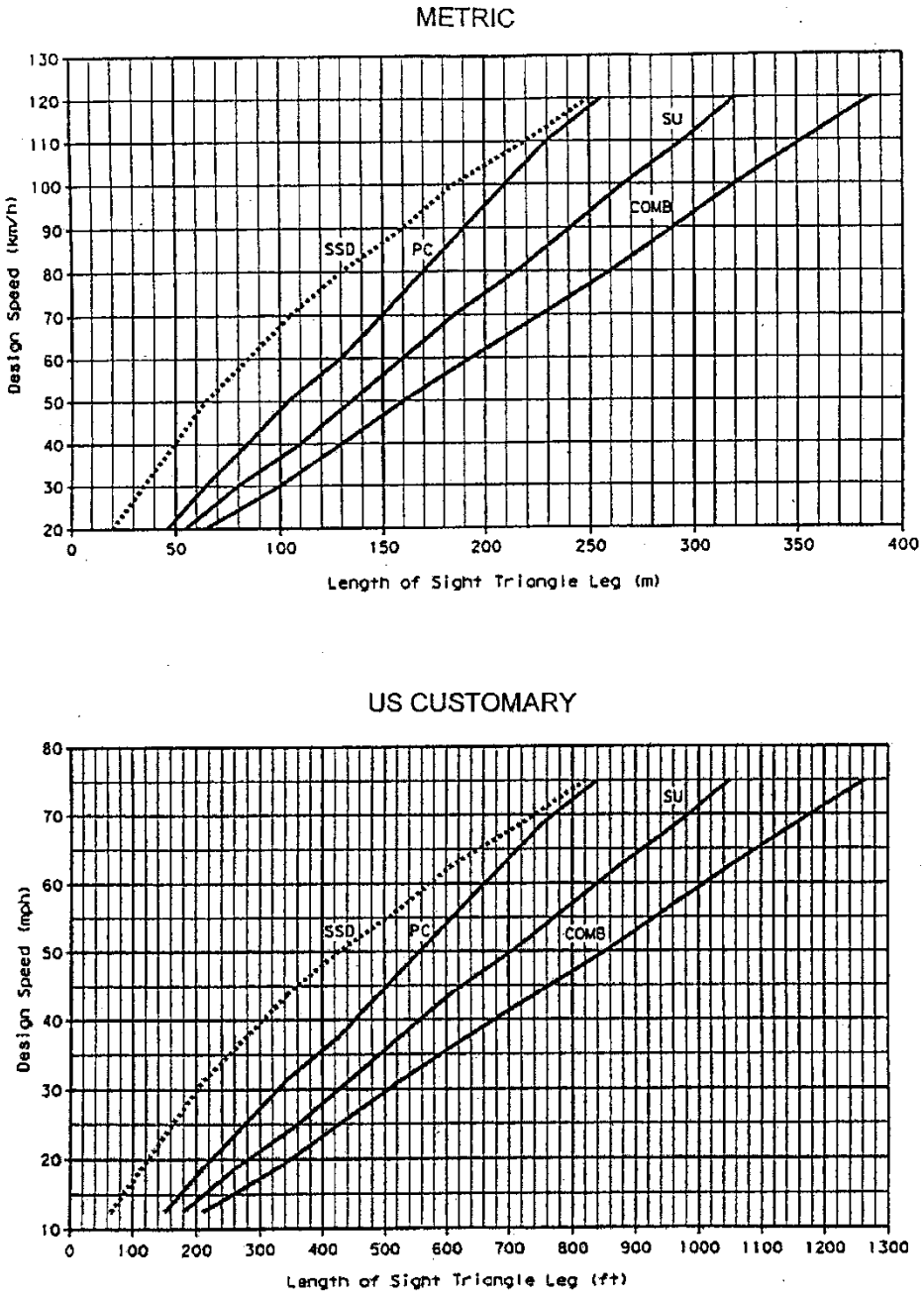


Exhibit 9-56. Intersection Sight Distance—Case B1—Left Turn from Stop

Design vehicle	Time gap (s) at design speed of major road (t_g)
Passenger car	5.5
Single-unit truck	6.5
Combination truck	7.5

Adjustment for multilane highways:

For left-turning vehicles that cross more than one opposing lane, add 0.5 seconds for passenger cars and 0.7 seconds for trucks for each additional lane to be crossed.

Exhibit 9-66. Time Gap for Case F—Left Turns From the Major Road

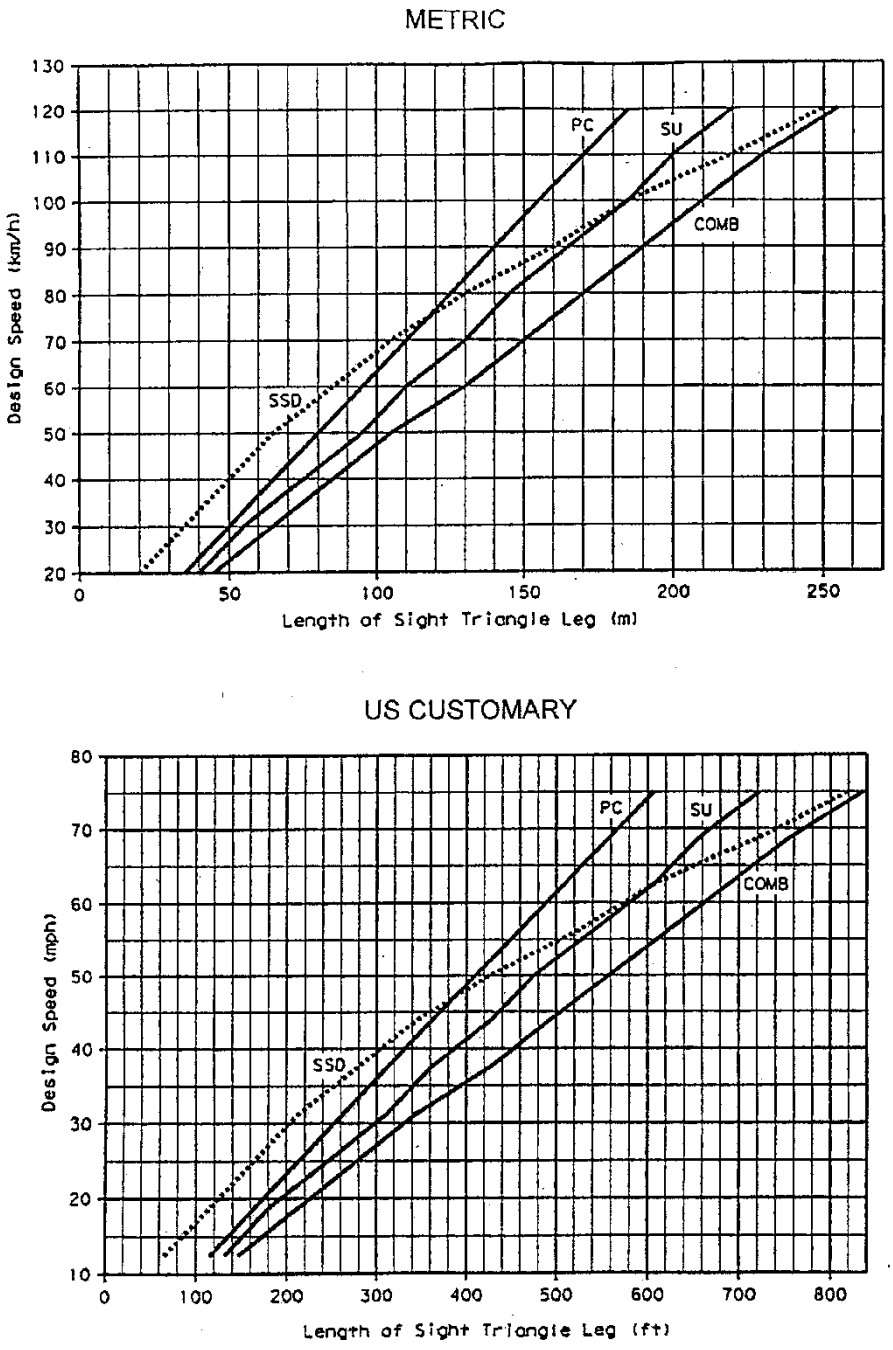


Exhibit 9-68. Intersection Sight Distance—Case F—Left Turn from Major Road

SIGNALS – WARRANTS FOR INSTALLATION/REMOVAL

Installation

It is the policy of this department to install traffic control signals only where signalized operation is preferable to unsignalized operation based on the following.

1. One or more of the Warrants for Installation of Traffic Control Signals in the MUTCD is met. The comprehensive signal warrant sheet used by MCDOT outlines these warrants.

2. The safety of the intersection would be enhanced by conversion to signalized control vs unsignalized control. An accident analysis should reveal accident patterns correctable by signalized control (ie - right-angle type accidents). These correctable patterns need to be strong enough where their correction more than offsets the potential for increase in accident patterns created by signalized control (ie - rear-end type accidents).

3. The vehicular capacity of the intersection (benchmarked by overall intersection delay) should be increased by conversion to signalized control. An increase in capacity needs to be exhibited by a decrease in overall intersection delay. Signalization will generally reduce minor street approach delays but increase delay on the major street.

As mentioned above, traffic signals can have definite drawbacks if they are installed where not absolutely necessary. Some of those drawbacks are as follows.

- An increase in rear-end type accident patterns

- An increase in overall intersection delay, particularly during off-peak periods

These drawbacks need to be offset by the expectation that signalization will correct existing adverse conditions under unsignalized control such as strong patterns of accidents correctable by signalization (ie – right angle type accidents) and long delays experienced by movements on the side street (ie – left turns or crossing maneuvers). When conditions that no longer justify signal control exist, the signal should be removed and unsignalized control re-established.

Non-Conflicting Right Turns

If the side street approach with the heavier traffic volume used in the traffic signal warrants has a lane primarily used by right turns, the proportion of right turns delayed less than seven seconds are to be removed from the right turning side street volume used in the evaluation of the traffic signal warrants. These are called non-conflicting right turns because they would have turned right on red without calling the signal and thus would not benefit from a traffic signal.

To determine this proportion, delay studies are conducted during one or more time periods representative of the hours evaluated in the warrants. The right turn traffic volume used in the evaluation of the signal warrants is reduced by the percent of right turns delayed less than seven seconds.

Comprehensive Signal Warrant Sheet
Monroe County Department of Transportation
Signals Engineering Division - Traffic Studies Unit

Town:	
Intersection:	
Evaluator:	
Date:	

Vehicular/Pedestrian Data

	Major Street	**Minor Street (higher traffic approach)**
Street Name:		
Data Type:		
Date(s) Collected:		
# Travel Lanes* (each inbound appr):		
RT Only Lane?:		
85th % Speed >40?:		
Ped Spd >3.5 ft/s?:		

* Include auxiliary lanes only if they carry a significant portion of the total volume on the approach

		Minor (Highest Approach)						**Major**	**Crossing Major**	
Hour	**Time**	**RT (All)**	**% RT Incl.**	**RT (Net)**	**TH**	**LT**	**Min Total**	**Maj Total**	**# Ped's**	**Gaps? (1/min)**
1										
2										
3										
4										
5										
6										
7										
8										
AM Pk										
PM Pk										

Accident Data

Period	**# Months**	**# Correctable Acc**

Vehicular Delay Data

Time Period	**Length (hours)**	**Left Turns**		**Right Turns**		**All Vehicles**		**Tot Delay (veh-hrs)**
		# Veh	**Av Delay**	**# Veh**	**Av Delay**	**# Veh**	**Av Delay**	

Warrant 1 - Eight-Hour Vehicular Volume (Tables from 2003 National MUTCD)

Table 4C-1. Warrant 1, Eight-Hour Vehicular Volume

Condition A—Minimum Vehicular Volume									
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1.....	1.....	500	400	350	280	150	120	105	84
2 or more...	1.....	600	480	420	336	150	120	105	84
2 or more...	2 or more...	600	480	420	336	200	160	140	112
1.....	2 or more....	500	400	350	280	200	160	140	112

[a] Basic minimum hourly volume.
[b] Used for combination of Conditions A and B after adequate trial of other remedial measures.
[c] May be used when the major-street speed exceeds 70 km/h or exceeds 40 mph or in an isolated community with a population of less than 10,000.
[d] May be used for combination of Conditions A and B after adequate trial of other remedial measures when the major-street speed exceeds 70 km/h or exceeds 40 mph or in an isolated community with a population of less than 10,000.

Condition B—Interruption of Continuous Traffic									
Number of lanes for moving traffic on each approach		Vehicles per hour on major street (total of both approaches)				Vehicles per hour on higher-volume minor-street approach (one direction only)			
Major Street	Minor Street	100%[a]	80%[b]	70%[c]	56%[d]	100%[a]	80%[b]	70%[c]	56%[d]
1.....	1.....	750	600	525	420	75	60	53	42
2 or more...	1.....	900	720	630	504	75	60	53	42
2 or more...	2 or more...	900	720	630	504	100	80	70	56
1.....	2 or more....	750	600	525	420	100	80	70	56

Condition A **OR** Condition B must be met for any eight hours of an average day for Warrant 1 to be met. If either of those conditions are not met for any eight hours, 80 % of Condition A **AND** 80 % of Condition B met for any eight hours will meet Warrant 1.

Warrant 2 - Four Hour Volumes

Warrant 2 is met if traffic on the major and minor streets for any four hours plotted on the attached figure 4C-1 or 4C-2 (if the speed on the major street exceeds 40 MPH) fall above the appropriate line

Warrant 3 - Peak Hour Delay

Warrant 3 is met if for any one hour of the day the following is met.

1. 650 or more vehicles enter the intersection if it has three approaches; 800 or more vehicles if it has four approaches, AND
2. On a one lane minor street approach, 100 or more entering vehicles on the minor street AND total delay of four vehicle-hours or more; on a two lane minor street approach, 150 or more entering vehicles on the minor street AND total delay of five vehicle-hours or more, OR
3. If traffic on the major and minor streets for any one hour plotted on the attached figure 4C-3 or 4C-4 (if the speed on the major street exceeds 40 MPH) falls above the appropriate line.

Warrant 4 - Minimum Pedestrian Volume (with inadequate gaps)

	Walk Speed > 3.5 ft/s	**Walk Speed < 3.5 ft/s**
Four Hours	100 per hour	50 per hour
One Hour	190	95

A pedestrian signal should not be installed if there is another traffic control signal within 300 feet.

Warrant 5 - School Crossing

Warrant 5 is met if there is a designated school crossing across the major street AND there are inadequate gaps during the period when school children are crossing AND there are a minimum of 20 school pedestrians per hour.

Warrant 6 - Progressive Movement

A traffic signal may be justified as part of a coordinated signal system. Its operation should serve to sustain progressive movement and proper vehicle grouping at the system speed.

Warrant 7 - Accident Experience

Warrant 7 is met if five or more reportable accidents of a type susceptible to correction by a traffic signal occur within a twelve month period AND at least 80 percent of the requirements specified either in Warrants 1 or 4 are met.

Warrant 8 - Systems Warrant

A traffic signal may be justified at the intersection of two major routes (existing or planned) to encourage organization and concentration of traffic flow.

Hourly Warrant Evaluation of Traffic Volume Data

In the case of a 1 lane (1 Ln) minor street approach, you have the option to evaluate the addition of an auxiliary lane that would carry a significant portion of the total approach volume. The 2 lane case (2 Ln) will see if the addition of the lane would affect meeting the warrants. What met the warrants with 1 lane may not with 2 lanes.

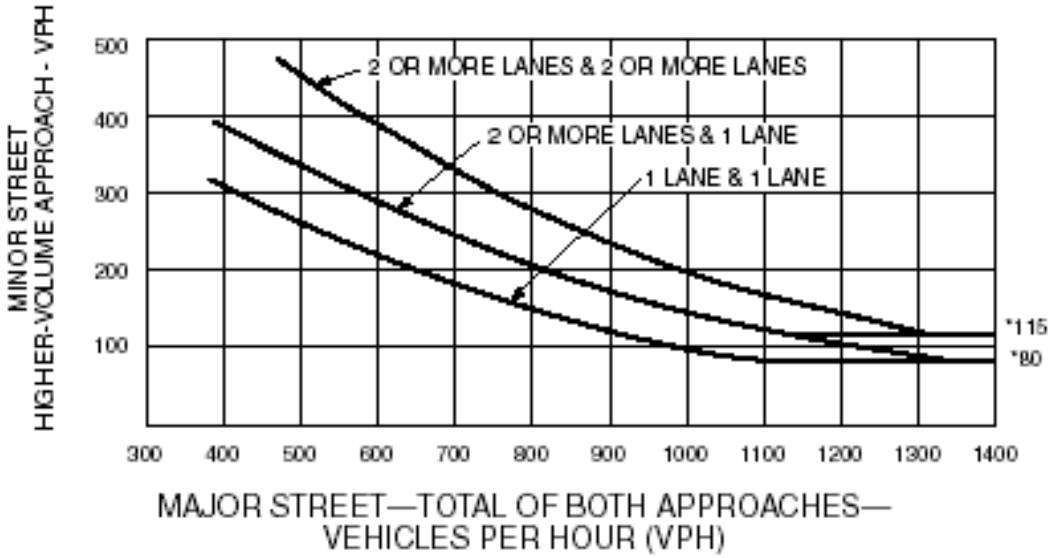
		Warrant 1 Met?		Warrant 2 Met?		War 3?	War 4?
Hour	**Time**	**1 Ln**	**2 Ln**	**1 Ln**	**2 Ln**		
1							
2							
3							
4							
5							
6							
7							
8							
AM Pk							
PM Pk							

Summary of Warrant Evaluations

	Warrant Met?	
	1 Lane Case	**2 Lane Case**
Warrant 1		
Warrant 2		
Warrant 3		
Warrant 4		
Warrant 5		
Warrant 6		
Warrant 7		
Warrant 8		

Comments:

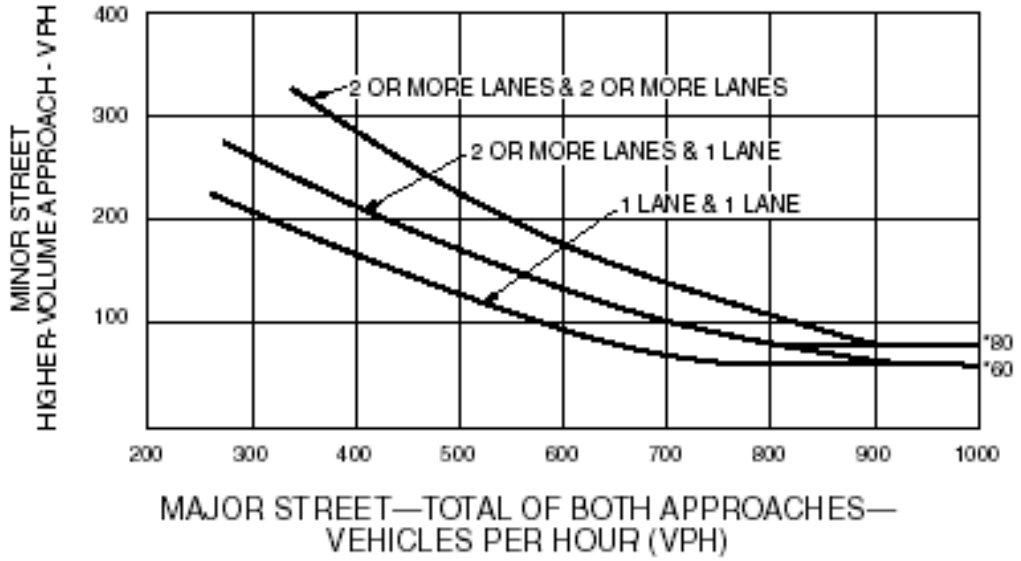
Figure 4C-1. Warrant 2, Four-Hour Vehicular Volume



*Note: 115 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 80 vph applies as the lower threshold volume for a minor-street approach with one lane.

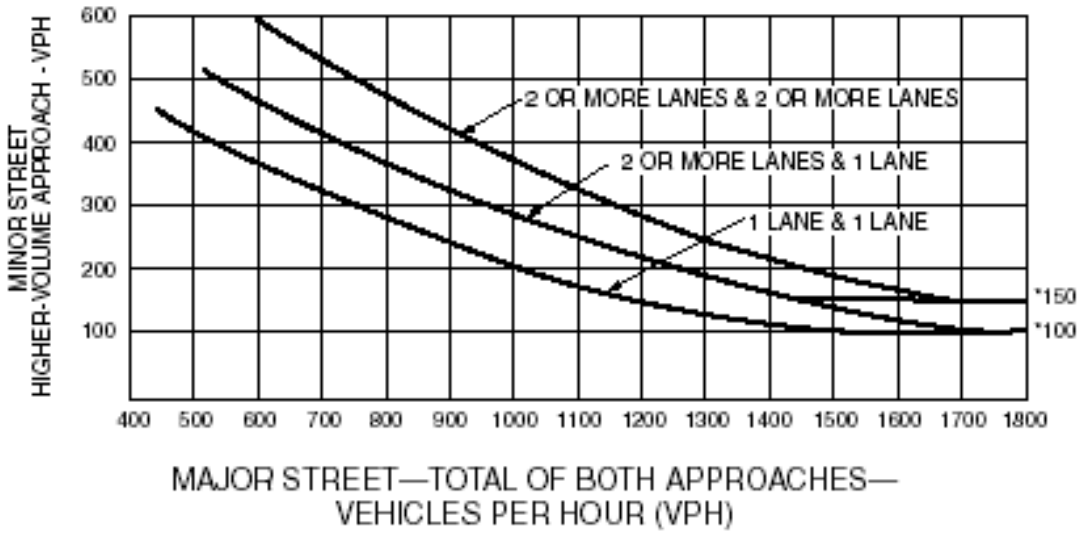
Figure 4C-2. Warrant 2, Four-Hour Vehicular Volume (70% Factor)

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 70 km/h OR ABOVE 40 mph ON MAJOR STREET)



*Note: 80 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 60 vph applies as the lower threshold volume for a minor-street approach with one lane.

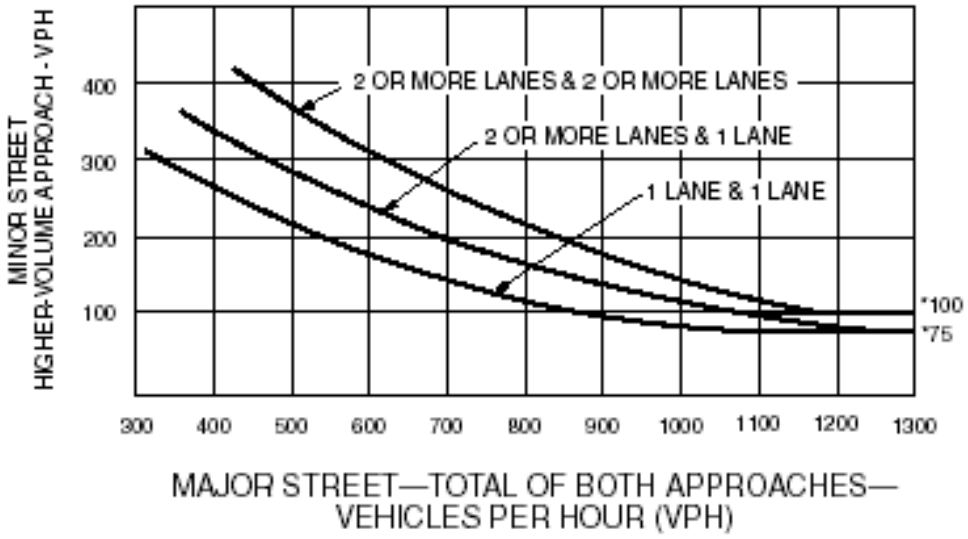
Figure 4C-3. Warrant 3, Peak Hour



*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

Figure 4C-4. Warrant 3, Peak Hour (70% Factor)

(COMMUNITY LESS THAN 10,000 POPULATION OR ABOVE 70 km/h OR ABOVE 40 mph ON MAJOR STREET)



*Note: 100 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 75 vph applies as the lower threshold volume for a minor-street approach with one lane.

Overview of the Process For Approving and Installing a New Traffic Signal – rev. 7/10/03

1. The need for a traffic signal is identified from a variety of possible sources, including:
- A complaint call, letter, or e-mail from a citizen;
- A development driven traffic study predicting changes in traffic conditions;
- A capital improvement project;
- The High Accident Location Program; or
- An internally generated study.

2. A study is conducted to determine whether a traffic signal is justified and necessary. This study could be conducted by:
- Our in house staff; or
- A consultant traffic report, which our staff would review.

3. The study's findings are reviewed to determine if the proper criteria are met. These would include:
- One or more of the Standard National and State Traffic Signal Warrants (minimum criteria for volume, number of accidents, delays, etc.) should be satisfied.
- A capacity analysis showing acceptable operation with a traffic signal.
- Verification that lesser means of traffic control (i.e. stop sign operation) will not suffice.

4. A formal recommendation for a change to traffic signal control is made by either the Permits section (for development driven locations outside the City of Rochester) or by the Studies section (for all other situations). This recommendation is reviewed by the Traffic Signal Engineer and approved by the Department Head. Locations within the City of Rochester are submitted to the Traffic Control Board for further approval. Locations outside the City of Rochester need to be approved by the appropriate Town Board.

5. Upon approval, the traffic signal is designed by either a consultant or in house staff. It is also placed on the project review and construction listing for tracking purposes, and it receives a unique traffic signal number.

6. Upon design completion, the signal drawings are distributed to all those involved in construction, inspection, and the furnishing of parts such as cabinets.

7. Installation is performed by in house or contractor forces.

8. Turn on is preceded by the issuance of timing sheets, several days of flashing operation, and an inspection.

9. On the day of turn on, an inventory sheet is prepared listing all of the components at the location. This is done primarily to report energy consumption, but also serves as a way to record the assets for other purposes.

10. Once the traffic has had time to adjust to the new signal, the Traffic Signal Engineer conducts an operational review in the field to ensure the timings and operation are efficient.

11. The change in energy consumption is reported to RG&E. This report triggers the close out of the item on the project review and construction listing, ending the process.

Removal of Traffic Signals

Traffic signals should be considered for removal when the following conditions are revealed.

1. The vehicular/pedestrian traffic volume no longer meets the warrants in the MUTCD for signal installation
2. A capacity analysis of the appropriate peak hours (usually AM and PM peak hours) identifies adequate operation of all movements under unsignalized control and comparable overall intersection delay
3. Pedestrian traffic at the intersection does not need the signal to cross safely and/or there is another nearby location they can cross with comparable safety
4. The intersection has adequate sight distance to operate safely under unsignalized control.

When a signal has been identified as a candidate for removal, the following procedure is initiated. Citizen input from area residents and business-people is also solicited throughout the process.

1. The signal is placed on red/yellow flash with the installation of stop signs (or red/red flash in the case of conversion to a four way stop control) for a trial period of six to twelve months.
2. During this trial period, the intersection is monitored for excessive delays and/or conflicts created by the conversion. Should they be revealed, the trial may be stopped and the signal re-activated.
3. After the trial period has elapsed, an accident analysis is done to see if any accident patterns were created during the trial period that indicate reactivation of the signal is appropriate.
4. If the accident analysis reveals that adequate safety was maintained during the trial period, and no excessive delays were evident, the signal heads can be turned off. In some cases it may be necessary to leave the hardware in place and bag the signal heads for another trial period, often six months. This trial period is optional depending on the circumstances, particularly if the first trial identified potential circumstances that might require a future reactivation of the signal.
5. If an accident analysis conducted after the second trial period (when the signal heads were bagged) reveals a continued adequate level of safety, the signal hardware (heads, poles, cabinet, etc.) can be removed.

Sometimes, under capital projects, an intersection needs geometric changes (such as bump-outs to improve sight distance and/or narrow the side street approach) before it can safely operate as an unsignalized intersection. In this case, it may be better to defer initiation of flashing operation until the construction of the changes has been initiated. Signal removal input would be handled by the project's public input process. The interim accident analysis may be waived if the intersection is being changed by the project to directly address safety. Any other problems, such as delays or conflicts, would be monitored by the project as it is being constructed.

SIGNAL PHASING GUIDELINES

LEFT TURN PHASE

A left turn arrow phase may be considered when one or more of the following conditions are met. Even when the conditions are met, the addition of the arrow phase should be anticipated to reduce the overall intersection delay.

1. If in any direction, the product of left turning vehicles and opposing through plus right turning vehicles during the AM or PM peak hour is greater than l00,000 (50,000 for a single lane approach)

2. Left turn volume greater than l00 vehicles (or 90 for a single lane approach) during the peak hours. For intersections where the 85th percentile approach speed is greater than 45 MPH, left turn volumes are reduced to 50 (45).

3. A vehicle delay study for left turning vehicles during the peak hours finds vehicle delays to be greater than two cycles.

4. Average delay for left turning vehicles during the peak hour exceeds 60 seconds.

5. The accident history reveals four or more left turn type accidents involving a left turn from a single approach within a l2 month period or six accidents within two years; or for left turns from two opposing approaches combined, six left turn type accidents in one year or ten in two years.

For approaches without left turn lanes, the initial consideration should be to create a left turn lane before left turn phasing. Left turn phasing is very ineffective without left turn lanes because only left turning vehicles near the front of the queue can utilize the arrow. The rest cannot reach the front of the queue in time due to their being mixed in with through vehicles. Again, the treatment should be anticipated to reduce the overall intersection delay. Should pavement width restrictions make creation of left turn lanes impractical and there is an accident pattern involving left turning vehicles, other measures such as full time or part time restrictions on left turn movements should be considered before left turn phasing.

LEADING vs. LAGGING LEFT TURN PHASE

A leading left turn arrow phase comes up before the green ball phase, a lagging left turn arrow phase comes up after the green ball. Each has advantages and disadvantages. With a leading phase, most of the left turns will turn on the arrow and thus be protected for better safety. This flushing out of the lefts also means that their delay is lower and less storage is needed for them. A disadvantage is that a left turn only lane is needed for efficient operation since a through vehicle would also call the phase if stopped in a shared lane. Another disadvantage is that, even with a left turn only lane, the phase will come up every cycle if a left turning vehicle is present regardless of whether the lefts could have cleared on the permissive green ball phase. A lagging left turn phase allows most of the left turns to clear on the permissive green ball phase and will only come up if the lane is still occupied at the end of the green ball. Although a left turn only lane is desirable, it is

not required for efficient operation. Lag lefts can result in very efficient operation at three-way intersections or where one or more of the streets are one-way. A

disadvantage is that a lagging permissive/protected phase (explained below) cannot be implemented at a four way intersection unless the two opposing directions have their left turns locked together because conflicts and accident patterns will develop between the through traffic going on the lagging phase and opposing left turns.

Locking the left turns together is when opposing left turns get the arrow at the same time. This phase can be either leading or lagging, and must have balanced left turn volume and a left turn only lane in each direction for efficient operation. Separating out the left turn phases can be beneficial when there are unbalanced left turn and/or through traffic volumes in opposing directions, but a lead left is required for the separation. All traffic on one approach gets the green arrow and ball while traffic in the opposing direction has a red ball. A left turn only lane is beneficial for efficient operation but is not required.

There are two modes of left turn arrow control, protected/permitted left turn and protected/prohibited left turn.

PROTECTED/PERMITTED MODE

Protected/permitted phasing is when left turns can move either on the arrow or the green ball. Vehicles can turn left with the arrow (protected) or with the green whenever there is an adequate gap in opposing traffic (permitted). In addition, there are four distinct operational schemes that may be used:

- Lead-left turn with parallel through movement.
- Simultaneous lead-left turns with parallel through traffic stopped.
- Lag-left turn with parallel through movement (only at "T" intersections).
- Simultaneous lag-left turns with parallel through traffic stopped.

Once all the traffic data is gathered and reviewed, good sound engineering judgment is used in the final analysis to determine if a left turn phase is appropriate. The final selection of phasing should also consider the effects of progression in a coordinated system.

PROTECTED/PROHIBITED MODE

In some cases, making a left turn on the green ball may not be safe. Examples include poor visibility of oncoming traffic, heavy U-turn movements, and turns made from multiple exclusive lanes. For such situations, it may be necessary to only allow the left turns during the arrow phase.

The protected/prohibited mode is relatively straight forward in that left turning traffic moves on a left green arrow and only on a left green arrow display. A separate left turn signal face must be used

where the sequence does not provide simultaneous right-of-way to parallel through traffic. In most cases, an exclusive left turn lane is utilized.

It is not as efficient as protected/permitted phasing because left turns are not allowed to use any gaps in opposing traffic while the signal is green. Typically, there is a loss of capacity at the intersection and an increase in queuing for the left turn movement. Therefore, protected only left turn phasing should be reserved only for situations where a left turn safety issue overrides the efficiency disadvantages of this type of phasing.

GUIDELINE FOR IMPLEMENTING 4 OR MORE PHASE SIGNAL

The purpose of this is to determine when additional phases may be justified at a signalized intersection. The following criteria should be considered.

- Directional distribution of traffic. Is there an unbalanced flow of traffic AM and PM?
- Unusual geometrics, more than four approaches or skewed.
- Heavy left turn volumes on all approaches.
- Heavy pedestrian activity on all approaches.

Figure 15 – Left Turn Phase Warrant Sheet

WARRANT SHEET - LEFT TURN PHASING

Justification

A left turn phase may be installed, subject to meeting one or more of the following conditions and based on sound engineering judgment.

	YES	NO
- The product of left turning vehicles and conflicting TH + RT vehicles during the peak hour is greater than 100,000 (or 50,000 for a single lane approach).	____	____
1) EB left x WB(TH+RT)= _____ 2) WB left x EB(TH+RT)= _____		
3) NB left x SB(TH+RT)= _____ 4) SB left x NB(TH+RT)= _____		
- Left turn volume greater than 100 vehicles (or 90 for a single lane approach) during the peak hours. For intersections where the prevailing speed is greater than 45 MPH, left turn volumes are reduced to 50 (45).	____	____
- A vehicle delay study for left turning vehicles during the peak hours finds vehicle delays to be greater than two cycles.	____	____
- Average delay for left turning vehicles during the peak hour exceeds 60 seconds.	____	____
- The accident history reveals four (4) or more left turn accidents for one approach within a 12 month period or six (6) in two years; or for both approaches, six (6) left turn accidents in one year or ten (10) in two years.	____	____

RIGHT TURN PHASE

The addition of a right turn arrow phase usually does not have the potential for negative impact on overall intersection delay that left turn phasing does because it is usually designed to operate concurrently with other protected phases. As in the case of left turn phasing, right turn phasing operates best when the arrow controls an exclusive turn lane rather than a shared lane. It can be very frustrating for right turning vehicles in a shared through/right lane to see the arrow and have through vehicles stopped in front of them prevent them from advancing. Some conditions under which right turn phasing can be considered include the following.

1. When an accident pattern involving conflicts with right turning vehicles has been identified

2. When the right turn volume on an approach is particularly heavy and implementation of the arrow would be anticipated to reduce overall intersection delay

3. To operate in conjunction with pedestrian phases for non-conflicting movements

4. On an approach with dual right turn movements to prevent conflicts in the outbound acceptance lanes

Whenever right turn arrows are being considered, care must be taken to not run such arrows in conflict with any pedestrian movements.

SIGNALS - PEDESTRIAN ACCOMMODATIONS

LEADING PEDESTRIAN INTERVAL GUIDELINES

The leading pedestrian interval provides pedestrians with a head start by delaying the parallel vehicle movements. This improves vehicle yielding behavior by allowing the pedestrians to occupy the crosswalk first, rather than releasing the vehicles and pedestrians simultaneously.

The standard pedestrian provision for initiating a crossing is a "walk" interval. During this interval, as well as the flashing "don't walk" interval that follows, pedestrians legally have the right-of-way over vehicles in the crosswalk. In most cases, this is adequate, and a leading pedestrian interval is not needed.

The leading pedestrian interval adds extra delay time that is essentially an extended all-red period for vehicles. The capacity of the intersection will be reduced accordingly. At capacity constrained intersections, the resulting increase in congestion could lead to a net decrease in safety. Therefore, leading pedestrian intervals should be used only when they are justified.

There are two situations where pedestrians may need additional assistance in starting their crossing through a leading pedestrian interval. These cases are discussed individually below.

- Case 1 – High pedestrian/vehicle conflicts due to volume.

  When vehicle right turning movements (or left turning movements from one way streets) are especially heavy, pedestrians may have a difficult time initiating their crossing. This is evidenced by vehicles consistently dominating the crossing at the start of green with pedestrians present, and is best determined by direct observation. In this case, adding a leading pedestrian interval of approximately four seconds is sufficient to give the pedestrians the first opportunity to occupy the crosswalk. If four seconds are taken away from two different streets, it will reduce the intersection's capacity by approximately 10%, which is significant, especially since by their nature, intersections that fall under Case 1 are often operating close to capacity.

- Case 2 – Pedestrian/vehicle conflicts due to geometrics.

  Some intersection crosswalks have geometric features, such as pedestrians moving concurrently with dual permissive left turns, which can make vehicle yielding behavior less likely. Adding a leading pedestrian interval for that crosswalk can help by placing the pedestrians in a position where they can clearly be seen, thus reducing ambiguity over who should occupy the crosswalk area first. In Case 2 situations, consideration should be given to placing the pedestrians on an exclusive pedestrian phase. If concurrent phasing is the preferred option, the provided vehicle delay should be long enough to allow the pedestrian to walk to the vicinity of the point of conflict (using the walking direction that begins from farthest away) before the conflicting vehicles are released. In practice, as drivers start up and begin to accelerate toward the area of potential conflict, the pedestrian is already there and has begun the process of clearing through it. Typical values for leading pedestrian intervals in Case 2 range from seven to twelve seconds. The reduction in intersection capacity depends on how many crosswalks are treated.

In neither case is the intent to fully cross the pedestrian before the vehicles are released. When that type of treatment is desired, the pedestrians and vehicles should be placed on separate phases that

do not move concurrently. Rather, this treatment is intended to concurrently allow vehicles and pedestrians, accompanied with provisions to increase the likelihood of vehicle yielding behavior.

Note that in timing a leading pedestrian interval, the vehicle delay time does not need to match the "walk" interval duration. These two variables are independently set. Vehicles can be released during the "walk" interval, during the flashing "don't walk" interval, or at the point where the change is made from "walk" to flashing "don't walk".

If a pedestrian phase is not button actuated (such as at a pre-timed intersection), the leading pedestrian interval will impose unnecessary delays on the vehicles when pedestrians are not present. In this case, if the feature is justified, the leading pedestrian interval can be operated on a part time basis during times when pedestrian activity is steady, and omitted at other times.

Leading pedestrian intervals need to be applied carefully when protected-permissive left turn phasing is provided for vehicles. The leading left turn phase that conflicts with the crosswalk will necessarily need to be changed to a lagging left turn phase (since vehicles and pedestrians cannot both go first). Lagging protected-permissive left turn operation can be unsafe at a four way intersection if the opposing left turns do not operate together. Although there is a work around by tying the two left turn phases together, this operation may increase delays, especially if the left turn volumes are not similar. In some cases, lag lefts may degrade the progression along an arterial. These factors will need to be considered when deciding whether to add a leading pedestrian interval at an intersection with protected-permissive left turn phasing.

COUNTDOWN PEDESTRIAN SIGNAL DEVICES

A device called the "countdown pedestrian signal" has been developed which displays to pedestrians the number of seconds remaining on the flashing "don't walk" interval. The device is intended to notify pedestrians how long it will be before the flashing "don't walk" time has expired. This expiration is the point in time where they should have completed their crossing. This information in turn may guide them in their decision making process as they either initiate or complete a crossing of the street.

The National MUTCD describes them as an optional device, but does not offer specific guidance on when it is appropriate to use them. NYSDOT Region 4 is using them on new projects at intersections for crosswalks across the primary street, and does not use them across side streets. They do not have any other criteria for their deployment.

Cost is a significant issue with these devices. In addition to the cost of purchasing and installing them, there is a very significant energy cost to operate them. There is also the potential for both mechanical failure (based on experience by NYSDOT signals) and erroneous information being displayed on the device (as per the caution in the National MUTCD guidance). Therefore, this device should be used selectively where it would provide the most benefit to pedestrians.

Typically, the crossing time is set with an assumed walking speed of 3.5 feet per second so that the pedestrian can reach the vicinity of the far curb when the crossing time has expired. Many pedestrians walk at speeds higher than this rate. According to ITE's *Toolbox on Intersection Safety and Design*, walking speeds range up to 6.0 feet per second. Table 1 illustrates the difference in crossing times at these various speeds. The table assumes 12 foot lanes and adds 12 feet to each situation to allow for the extra distance introduced by the curb radii typically found at an intersection. It also assumes there is no significant skew angle in the crosswalk.

Typical Pedestrian Crossing Times at 3.5 feet per second and 6.0 feet per second

Table VI

	Number of Lanes To Cross (12 foot lanes plus 12 feet for corner radii)			
	2 Lanes To Cross	3 Lanes To Cross	4 Lanes To Cross	5 Lanes To Cross
Typical Distance	36 feet	48 feet	60 feet	72 feet
Time @ 3.5 ft/sec	11 seconds	14 seconds	18 seconds	21 seconds
Time @ 6.0 ft/sec	6 seconds	8 seconds	10 seconds	12 seconds
Time Difference	5 seconds	6 seconds	8 seconds	9 seconds

The time difference reflects extra time that a fast walking person theoretically has to work with. The table demonstrates the increased usefulness of the device as the crosswalk distance gets longer, especially in cases of extreme length. The longest crosswalks that we operate (NYSDOT crosswalks across West Ridge Road at Hoover Drive and Buckman Road) have a clearance time of 30 seconds, can be walked in 20 seconds at 6.0 feet/second, and have a time difference of 10 seconds. They have countdown pedestrian signals in place, and the value of them is apparent.

Another consideration is the influence of conflicting vehicles that could delay a pedestrian briefly during the flashing "don't walk" interval. Locations with heavier right and left turning vehicle volumes have a higher potential to delay a pedestrian's crossing. The time remaining information would be helpful in this situation to reassure a pedestrian that there is still adequate crossing time available for the completion of the crossing.

The following guidelines are recommended for the placement of countdown pedestrian signals. In considering whether to install the devices, the location should meet at least one and preferably two of the following thresholds.

1. Pedestrian countdown devices are recommended for the longer crossing lengths where crossing time variance is greatest. A suggested threshold is at least 60 feet of crossing distance.

2. Pedestrian countdown devices are recommended where the right turning and left turning volumes that conflict with the crosswalk are high. A suggested threshold is a combined 400 vehicles per hour (adding the conflicting right and left turning vehicle volumes together).

Although the devices could also be considered where the pedestrian volumes are high, the better adjustment for this situation is to add more "walk" start up time. Therefore, the primary need for the devices should be based on the two criteria listed above.

AUDIBLE/TACTILE PEDESTRIAN SIGNAL DEVICES

The following guidelines were established in July 1996 for evaluating requests for audible pedestrian signal devices. They have been updated to reference the community resources that are involved in reviewing the need for each location, and to incorporate the newer tactile devices.

1. We should first explain to all requestors that audible and tactile pedestrian signal devices are not universally accepted by the visually impaired community. Two primary objections are:

- Both types introduce a dependence on mechanical devices, which may fail; and

- The audible signal (usually the requested type) masks vehicle noises and may prevent the pedestrian from hearing an approaching vehicle that is not stopping for the red light.

Because of these objections and the cost involved in installing and maintaining the devices, and because requestors often move to other locations without notifying us, we are very selective on where they are installed, especially when only one individual is involved.

2. The following information should be gathered from the requesting party.

- Determine whether they have been in contact with an Orientation and Mobility specialist or other similar provider of evaluation and training for the visually impaired. An example of a local agency that provides this service is the Association for the Blind and Visually Impaired. If they have not done so, encourage the individual to contact these resources first to review the full range of alternatives available. Examples of other available options include formal training on audible cues that can be used to determine when it is safe to cross, crossing at an adjacent intersection which is more suitable, boarding a bus at a different stop, and using the crosswalk on the opposite side of the road.

- Establish the likelihood of usage. The requestor usually is able to indicate whether one individual or a group of visually impaired individuals utilize the crossing.

3. Once other options have been considered, review the individual crossing circumstances. There are two situations where audible or tactile pedestrian signal devices appear to be necessary. Determine if either of the situations apply.

Case 1 - The intersection is a non-standard, complicated crossing. Qualifying considerations include non-standard geometrics such as skewed intersection approaches, and unusual traffic signal phasing such as split phasing, exclusive pedestrian phasing, or multiple left turn phases that make it difficult for a pedestrian to cross safely based on audible cues alone. An example of such an intersection is Mount Hope Avenue at Crittenden Boulevard and East Henrietta Road, which has all of these factors.

Case 2 - The intersection has little or no side street traffic (as would be the case with a pedestrian signal) and therefore there are few audible cues available to determine when to start crossing. An example of Case 2 is S. Clinton Avenue at Karges Place, where the side street is not controlled by the traffic signal.

A local assistance agency should be utilized to help to evaluate whether the above cases apply and whether such a device is the best approach to the individual situation.

4. Based on the above, the possible outcomes are:

- If Case 1 and Case 2 do not apply, the request should be denied.

- If either Case 1 or Case 2 applies, the crossing is likely to be used by several individuals, and alternative crossing routes are not available, then the request should be approved.

- If either Case 1 or Case 2 applies, but only one individual is involved, work with the local assistance agency to exhaust any other options first. The concern is that individual needs are dependent on where they live and where they work; any change could render the installation obsolete, and we usually aren't notified when this happens. If no other reasonable options remain, then the request should be approved.

5. If the request is approved, install the appropriate type of device for the crossing. The tactile version is generally preferred because it is unobtrusive and subtle, but since the user must keep a hand on the device until it is time to cross, it should not be used if the pedestrian button location does not coincide with the crosswalk ramp. An audible device should be selected in those cases.

When the request is for only one individual, a letter can be sent annually to verify whether the individual still needs the device.

SITE PLAN REVIEW

As part of MCDOT's role as traffic engineers for the City of Rochester, we review site plans and traffic impact reports for new development that are referred to us. We participate in pre-application meetings with the applicant, consultants, and all involved agencies when they are conducted. We also participate in public meetings to present the proposal once our findings and recommendations are finalized.

Outline of What We Review

Site Plans

1. Access to the site to/from the public right-of-way

    a) Location and number of the proposed driveways as per necessity for on-site circulation, sight distance and potential conflicts
    b) Lane configuration and width needed for proper operation of the driveway
    c) Traffic control devices needed at the driveways
    d) Maneuvering of delivery trucks into and out of the site
    e) Impacts of driveways on adjacent public intersections (queuing, lane blockages)

2. On-site traffic circulation

    a) Review for potential conflict points
    b) Advise on mitigation of potential sources of congestion
    c) Routing to/from driveways that provide access to the public right-of-way
    d) On-site traffic control devices
    e) On-site loading facilities

Traffic Impact Reports

1. Threshold of additional trips generated that requires a traffic analysis or traffic impact report

    Our policy is if the proposal generates 100 or more additional trips per hour (entering plus exiting combined) within the AM or PM peak period, some kind of traffic analysis is needed. We can also recommend an analysis with less than 100 trips if there are other traffic issues in the area that would be exacerbated by the proposal.

2. Scope of the traffic analysis or traffic impact report

    We determine if the scope of the analysis should include just operation of the site accesses or if it should also cover other intersections and/or corridors in the area that would be significantly impacted. A good rule of thumb is to include all intersections with 100 trips or more per hour added to the AM or PM peak periods, plus any critical intersections close to that value that might be affected.

3. Review of the traffic report drafts

    a) Accuracy of the background traffic data provided to and collected by the consultant
    b) Accuracy of the number of the estimated additional trips generated and their distribution
    c) The consultants evaluation of the existing vs full build traffic operations
    d) Information in the capacity analysis (signal timings, phasing, lane usage, etc.)
    e) Their findings from the evaluation
    f) Their conclusions and recommended mitigating measures

4. Articulation of our findings and recommendations to all stakeholders

    We initially respond directly back to the point of contact with the City with copies to the applicant, consultants, and other involved agencies if needed. Should further reviews be needed and/or a public meeting, we follow through with further iterations of the above procedure.

FEE SCHEDULE FOR MCDOT REVIEW

Through the permit fee process, we also establish fees for reviewing documents. There is no charge for a site plan review. The fee schedule as of December 2007 is as follows.

Traffic Analysis (study of site driveways only) - $200

Minor Traffic Impact Report (site driveways plus nearby public intersections) - $500

Major Traffic Impact Report (intersections and corridors within a larger study area) - $800

In the above, a traffic impact report is considered “major” if the traffic generated by the site (incoming plus outgoing combined) is 100 vehicles per hour or more during any peak hour.

These fees may change over time based on actual costs, and are set by the Permits Section.

SPEED LIMITS ON COUNTY ROADS

Our policy is to establish realistic and enforceable speed limits on County roads. The most common request regarding speed limits is for a reduction in the existing posted speed limit. In response to these requests, we conduct a thorough traffic engineering study to determine if a lower speed limit is both realistic and enforceable.

Guidelines

All requests for a lower speed limit on a County roadway will proceed in the following manner.

1. If the current speed limit is the statewide maximum of 55 MPH, the speed zone criteria will be evaluated in accordance with guidelines established by the New York State Department of Transportation. Their criteria consider such factors as roadside development, geometric characteristics, and traffic volumes. The appropriate NYSDOT forms TE 24a-2 shall be filled out. An example of a completed form TE 24a-2 follows this section.

2. A speed analysis will be conducted from data gathered by either automatic traffic counters over a 48 hour period or by a sampling of at least 100 vehicles traveling in each direction by radar when use of automatic traffic counters is not practical. Statistics to be determined include the eighty-fifth percentile speed, the percent exceeding the existing and proposed speed limit, and the 10-MPH pace (the 10 MPH range of speeds where the highest percentage of samples fell).

3. A field review will be made to identify a comfortable travel speed, existing signs, significant vertical and horizontal curves, sight distance limitations, type of development, and character of the roadway.

4. The accident history for a two to three year period should be reviewed with a focus on speed related accidents.

Justification

A lower speed limit may be recommended if one or more of the following are met.

1. The NYSDOT speed zone criteria evaluation reveals roadside development and geometric characteristics that meet the warrant for a speed zone lower than 55 MPH (if the current speed limit is 55 MPH)

2. The speed analysis identifies either an 85th percentile speed or the upper limit of the 10-MPH pace, whichever is higher, to be not more than 5 MPH over the proposed speed and the percent of vehicles over the proposed speed limit is less than 30% so that only minimal enforcement is required

3. A field review reveals that travel at the proposed speed is comfortable and reasonable for the motorist, and therefore it is reasonable to expect compliance with it. Also, the character of the development is found to be compatible with the proposed speed limit (ie - residential vs rural character)

4. The accident history reveals enough speed related accidents to expect that a lower speed limit would reduce their frequency

As per the NYS Vehicle & Traffic Law, approval of speed limits on County roads within towns it designates as Type II (rural with lower populations) require the town to pass a town ordinance establishing the speed limit, approval by the County Highway Superintendent (via signature on NYSDOT form TE-9a), and final approval by the NYSDOT. MCDOT would then post the required signs. Within towns designated as Type I (urban with larger populations), the town has the power to establish the speed limit via the passing of a town ordinance, but only the County has the power to post the speed limit signs on County roads. Final approval by the NYSDOT is not needed.

Table VII

Type I Towns	**Type II Towns**
Brighton	Clarkson
Chili	Hamlin
Gates	Mendon
Greece	Riga
Irondequoit	Rush
Ogden	Sweden
Parma	Wheatland
Penfield	
Perinton	
Pittsford	
Webster	

Wells Saw Mill Rd Rt 251/H. Blvd to
55 MPH S.L. 1.6 mi.

TE 24a-2 (10/79)

FORM INSTRUCTIONS

1. In Part A, compute the Highway Development Index.
2. In Part B, compute the Highway Geometric Factor.
3. If the Highway Development Index is > 50, a speed zone is warranted. The numerical value of that limit should be established at the 85th percentile speed using the Speed Data Analysis Sheet (FORM TE 27) to compute it. If the 85th percentile speed is determined to be 55 MPH or greater, the statewide 55 MPH speed limit prevails and a specific linear limit need not be established.
4. If the Highway Development Index is between 0 and 50, enter the Criteria for Speed Zone Approval table under the Highway Development Index and find the range of values in which the computer Highway Development Index (Part A) is found. Compare the computed Highway Geometric Factor (Part B) to the corresponding Minimum Highway Geometric Factor in the table.

   a. If the computer Highway Geometric Factor is greater than or equal to the table value, a speed zone is warranted. The numerical value of that limit should be established at the 85th percentile speed using the Speed Data Analysis Sheet (FORM TE 27) to compute it. If the 85th percentile speed is determined to be 55 MPH or greater, the statewide 55 MPH speed limit prevails and a specific linear limit need not be established.

   b. If the computer Highway Geometric Factor is less than the table value, a speed zone is not warranted and should be denied.

Criteria for Speed Zone Approval

Highway Development Index	Minimum Highway Geometric Factor	
	≤ 3 Lanes	> 3 Lanes
0 – 10	7.1	6.7
11 – 20, 15	5.1 < 6.5	6.1
21 – 30	5.9	5.5
31 – 40	5.3	4.9
41 – 50	4.7	4.3
> 50	–	–

N07
MC7

TE 24a-3 (10/79)

HIGHWAY DEVELOPMENT INDEX & GEOMETRIC FACTOR DETERMINATION SHEET

Road Name & Route No.	Jurisdiction & SH, CR or TH No.		Length in Miles (nearest 10th)
Bull's Saw Mill Rd	Monroe County, CR 55		1.6 mi
Community	Town: Mendon	County: Monroe	Date: 4/12/06

From Rt 251 (Rush Mendon Rd) to W. Bloomfield Rd

Section Evaluated on this sheet - Identify with Respect to Data Sheet Line Diagram

A. HIGHWAY DEVELOPMENT INDEX

Roadside Development:*		Left	Right		Left	Right
Class I	– Number of Units	10	5	x 1.0 =	10	5
Class II	– Number of Units			x 2.0 =		
Class III	– Number of Units			x 3.0 =		
Class IV	– Number of Units			x 4.0 =		
					10	5

TOTAL ROADSIDE DEVELOPMENT

Distribution of Roadside Development:

Distribution Factor = $0.5 + \frac{S}{S+s} = 0.5 + \frac{10}{10+5} = .5 + .67$ = 1.17

S = No. of Units on the Side of Highway Having the Greater Roadside Development

s = No. of Units on the Side of Highway Having the Lesser Roadside Development

(Total Roadside Development x Distribution Factor) 15 x 1.17 = 18

Intersection Development:*			
Class A – Number	3	x 2.0 =	6
Class B – Number		x 3.0 =	0
Class C – Number		x 4.0 =	0
			24

TOTAL HIGHWAY DEVELOPMENT

HIGHWAY DEVELOPMENT INDEX = $\frac{\text{Total Highway Development}}{\text{Length of Section in Miles (nearest 10th)}}$ $\frac{24}{1.6}$ = 15

*See over for detailed explanation.

TE 24a-5 (10/79)

B. HIGHWAY GEOMETRIC FACTOR

Pavement:

Predominant Travel-Lane Width (Feet)	FACTOR			
	2 & 3 Lane Roadways	Roadways of More Than 3 Lanes		
		Undivided or Paved Flush Mall	Unpaved or Raised Mall Narrower Than 10 Feet	Unpaved or Raised Mall 10 Feet or Wider
8 or Less	1.6	1.4	1.0	0.9
9	1.4	1.2	0.9	0.8
10	1.2	1.0	0.8	0.7
(11)	1.1	0.9	0.7	0.6
12 or more	1.0	0.8	0.6	0.5

PAVEMENT FACTOR 1.1

Roadway Characteristics:* ☐ Excellent (1.0) ☒ Good (1.2) ☐ Average (1.4) ☐ Adverse (1.6) ☐ Poor (1.8)

ROADWAY FACTOR 1.2

Shoulders:* ☐ Good (0.9) ☒ Average (1.0) ☐ Poor (1.1)

SHOULDER FACTOR 1.0

Sidewalks: ☐ Inadequate or lacking where need exists (1.1) ☒ Adequate or unnecessary (1.0)

SIDEWALK FACTOR 1.0

Traffic:

AADT Volume 430
No. of Travel Lanes 2

Vehicles Per Lane Per Day	Factor
5000 or more	1.6
3500 to 5000	1.4
2000 to 2500	1.2
(Less than 1000)	0.8

TRAFFIC FACTOR 0.8

HIGHWAY GEOMETRIC FACTOR (TOTAL) 5.1

*See over for detailed explanation.

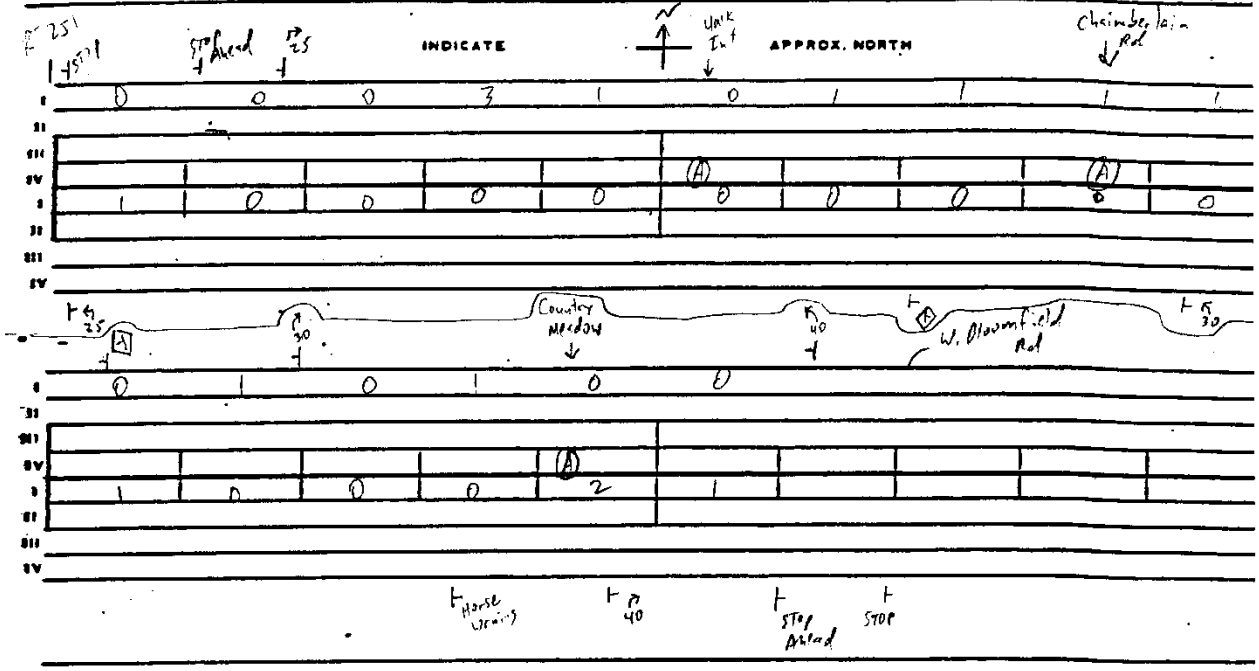
TE 22.13(7/69)

STATE OF NEW YORK – DEPARTMENT OF TRANSPORTATION
TRAFFIC ENGINEERING AND SAFETY DIVISION

LINEAR SPEED ZONE EVALUATION
DATA SHEET

TE FILE:

ROAD NAME AND ROUTE NUMBER	JURIS. & SH., CR., OR TH. NO.	LENGTH IN MILES (NEAREST TENTH)	OBSERVER
Golf Course Hill Rd, CR 55	Monroe County, CR 55	1.6 mi.	DMH/PBM
COMMUNITY	**TOWN**	**COUNTY**	**DATE**
	Mendon	Monroe	4/12/01



WIDTH AND TYPE OF PAVEMENT	ALIGNMENT	SIDEWALKS AND CURBS
26' asphalt	straight to curves	none
TRAVEL LANE WIDTH IN FEET	**GRADES**	**PEDESTRIAN MOVEMENT**
11'	none	none
NUMBER OF TRAVEL LANES	**SIGHT DISTANCE LIMITATIONS**	**PARKING PRACTICE**
2	none	none
SHOULDER WIDTH AND TYPE FEET 2-4' ~~TREATED~~ UNTREATED ~~GRASS~~	**WIDTH AND TYPE OF MALL** none	**AVERAGE DAILY TRAFFIC** 430 vpd

EXISTING DEVICES, REGULATIONS, ILLUMINATION, ETC.

See Above

ACCIDENT RECORD

See Attached

TE 24a-6 (10/79)

ROADWAY CHARACTERISTICS

Excellent — Essentially level and tangent, with no intersections, and excellent sight distance throughout.

Good — Minor curves and/or grades with sight distance above standard throughout; or few intersections, all Class A and all with good approach sight distance; or both.

Average — Moderate curves and/or grades with sight distance, if limited, not a predominant factor; or intersections which are a factor because of importance, number or poor sight distance; or both.

Adverse — Substantial curves and/or grades with limited sight distance a significant factor; or intersections which are a predominant factor because of importance, number or poor sight distance; or both.

Poor — Severe curves and/or grades requiring definitely reduced speed, with limited sight distance a dominant factor; or numerous or important intersections with poor sight distance; or both.

SHOULDERS

Good — Stable shoulder, generally 6 feet or wider.

Average — Stable shoulder, generally 2 feet to 6 feet wide.

Poor — Stable shoulder less than 2 feet wide;
Unstable shoulder of any width
Curbed section.

TE 24a-4 (10/79)

ROADSIDE DEVELOPMENT

Class I Residences, small commercial establishments, small public buildings and other units which generate light and/or occasional roadside activity.

Class II Average commercial establishments, district schools, trailer parks, light industries, public buildings and other units generating roadside activity which would fit one or more of the following descriptions:

1. Continuous, but light
2. Moderate at certain regular times, as during commuting hours
3. Substantial on infrequent occasions

Class III Heavy industries, central schools, shopping centers and units generating continuous moderate roadside activity, or substantial activity at certain regular times.

Class IV Large shopping centers and other units generating substantial and continuous roadside activity. Some large industries which are tourist attractions or for some other reason generate substantial activity, in addition to heavy commuting traffic volumes, would be included in this category.

INTERSECTION DEVELOPMENT

Class A Intersecting road is of substantially less importance. Side road traffic and turning movements have little effect on the traffic flow pattern of the road under study.

Class B Intersecting road is of lesser importance, but side road traffic and turning movements are such that intersection has appreciable effect on the traffic flow pattern of the road under study.

Class C Signalized intersections, and intersections with roads of comparable or greater importance. Intersections which have a pronounced effect on the traffic flow pattern of the road under study.

STOP LINES AND YIELD LINES

This Department is responsible for installing and maintaining stop lines on City streets as deemed justified by an engineering analysis. On County roadways, the installation and maintenance of stop lines is under the Town's jurisdiction at signalized locations and it is under the County's jurisdiction at unsignalized locations. This includes locations across the County roadway not at intersections. If the location is across a driveway or private road, installation and maintenance of the stop line is the responsibility of the property owner. MCDOT must approve their installation at any intersection under County jurisdiction as deemed justified by an engineering analysis. Markings covered due to any MCDOT paving or resurfacing will be the responsibility of the County.

The stop line should be used where it is considered important to indicate the point behind which vehicles are required, or may be required, to stop in compliance with a stop sign, traffic signal, or in conjunction with a marked crosswalk at signal or stop sign. Its use shall be only in conjunction with a traffic control device which requires, or may require, traffic to stop. Stop lines are recommended at signalized locations to help traffic stop over the detector loops and keep the intersection clear when the signal is red. At unsignalized locations, they may be used where the need for reinforcement of a stop sign has been identified or to designate to the driver where they should stop to obtain maximum sight distance. Regardless, stop lines should be placed to allow sufficient sight distance to all other approaches to the intersection.

The yield line should be used where it is considered important to indicate the point behind which vehicles are required, or may be required, to yield in compliance with a yield sign or in conjunction with a marked crosswalk. Its use shall be only in conjunction with a traffic control device which requires, or may require, traffic to yield. Regardless, yield lines should be placed to allow sufficient sight distance to all other approaches to the intersection. If yield lines are used in conjunction with an uncontrolled crosswalk, they will be used as per the MUTCD. They would be marked 20-50 feet in advance and in conjunction with "Yield Here to Pedestrians" signs.

TURN ON RED PROHIBITION

Policy

The "No Turn On Red" (NTOR) sign shall be used to indicate that a right turn on red (RTOR) or a left turn on red (LTOR) is not permitted under the generally permissive rule. LTOR can be permitted for left turns from a one way street onto another one way street. For RTOR the sign should be erected near the appropriate rightmost signal head or as near the near right corner as possible. For LTOR the sign should be erected near the appropriate leftmost signal head or as near the far left corner as possible. The prohibition may be in effect full time or part time depending on the findings of an engineering study.

Full Time Restriction

Full time restriction will be considered when one or more of the following conditions are determined to exist.

1. The sight distance to vehicles approaching from the left at their eight-fifth percentile speed due to a permanent or frequent obstruction falls within the blue area on the figure on page 40 (formerly Figure 232.1 from the 2003 NYSMUTCD). See the section on intersection ahead signs for explanation of the figure.

2. The intersection area has geometrics or operational characteristics that may result in unexpected conflicts. These include the following.

    a) Five or more approaches where the right turn would encounter a conflicting approach
    b) Restrictive geometrics such as a narrow lane to turn into and/or a turn angle sharper than 90 degrees
    c) Multi-phase signal design that may cause unexpected conflicts
    d) Right turn or left turn permitted from two or more lanes
    e) Railroad crossing interconnection
    f) Exclusive pedestrian phase which conflicts with the right turn or left turn movement
    g) Opposing approach has a protected left turn phase for turns from more than one lane
    h) Conflicting U-turn movement occurs on the cross street due to raised median treatment

    In some of the above cases under part 2, we can install a variable message sign that lights up “No Turn On Red” during the part of the signal cycle when the condition is present and is dark for the remainder of the cycle. Otherwise, a full-time static sign is needed.

3. More than three RTOR or LTOR accidents per year have been identified.

Part Time Restriction

Part time restrictions will be considered when one or more of the following conditions are determined to exist.

1. When the sight distance of vehicles approaching from the left (for RTOR) or from the right (for LTOR) due to a temporary obstruction (such as parked cars when parking is allowed during certain times) falls within the dark area on the figure on page 40 (was Figure 232.1 from the 2003 NYSMUTCD)

2. Capacity problems exist for acceptance lanes during peak or off peak hours

3. High pedestrian crossing volumes at the conflicting crosswalk

4. Significant numbers of school pedestrians cross, assisted or unassisted, during school arrival/dismissal times

5. Significant crossing activity by elderly or handicapped people

As noted earlier, sometimes a specific signal phase (opposing protected dual left turns, U-turns from the cross street, etc.) will cause a right turn on red motorist to not recognize the unique conflict when the protected phase is running for conflicting traffic. In this case, a sign can be installed that illuminates during the conflicting phase(s), but is extinguished the remainder of the time. This allows right turns on red when the conflicting situation is absent.

It should also be noted that the right turn on red prohibitions force all right turning vehicles to move on the green phase, which is the same time that pedestrians are expected to cross in the crosswalk to the right of the vehicle. Therefore, prohibiting right turns on red can increase the number of vehicle/pedestrian conflicts in that crosswalk while decreasing the conflicts in the crosswalk immediately in front of the driver. The net effect may decrease pedestrian safety in some cases. Therefore, NTOR should not be used indiscriminately or be considered to help pedestrians in all areas. It also reduces capacity, which can lead to other problems if the capacity is exceeded by the volumes. A similar situation exists for LTOR situations.

WEIGHT LIMITS

Weight limits, except for local delivery, should be enacted only if it can be demonstrated that there is a substantial relationship between the ordinance and the public welfare. Factors considered include the highways suitability for such travel and/or resulting damage to the street.

Weight limits should not be enacted if the development is of a commercial/industrial character, or if there is mixed residential/commercial development and normal conduct of business requires access to trucks.

The term "except local delivery" allows the delivery or pickup of merchandise or other property along the highways from which such vehicles are otherwise excluded.

Guidelines

All requests to enact weight limits on City or County roads shall proceed with one or more of the following studies.

1. A field review to determine width of roadway, turn radii around corners, development (commercial and/or residential), possible sources of truck traffic, parking, damage to curbs, utilities or trees, etc.

2. A vehicle classification count is conducted by using machine counters that classify vehicles according to wheel base and number of axles over a 48 hour period. This will identify the percentage of traffic that is made up of heavy trucks.

3. The accident history will reveal the involvement of trucks in accidents on the subject roadway. This should be done in conjunction with a vehicle class count to determine if there is a disproportionate share of truck accidents relative to truck frequency.

Justification

Weight limits, excluding local deliveries, may be enacted if one or more of the following applies:

1. An above average percentage of traffic on a residential street is made up of trucks and a suitable alternate route is available.

2. Trucks are involved in a disproportionate share of accidents relative to their frequency and a suitable alternate route is available.

3. Seasonal weakening of the road surface, damage to curbs, utilities or trees, obsolescence of bridges or pavements, or other impairment of the roadway make limiting of the load permitted necessary.

APPENDIX A - ACCIDENT PATTERN COUNTER-MEASURES

GENERAL COUNTERMEASURES FOR ACCIDENT PATTERNS AND THEIR PROBABLE CAUSES

The primary purpose of the accident pattern-cause-countermeasure table is to assist in establishing a list of general countermeasures (or possible improvements) for a high-accident location. It is assumed that certain accident patterns are associated with probable causes. Accident patterns are identified from accident summaries and collision diagrams. Probable causes relating to accident patterns are inferred from accident reports, on-site reviews, and other traffic studies conducted at the site.

This table is a basic guide to the general types of countermeasures that have been found to be effective in accident reduction. There may be other improvements not in the table that could possibly be appropriate for a particular high-accident location. Those improvements may have to be identified by professional judgment or by consulting with other engineers.

The accident pattern-cause-countermeasure table is organized according to the following accident patterns:

- Right-angle collisions at unsignalized intersections
- Right-angle collisions at signalized intersections
- Rear-end collisions at unsignalized intersections
- Rear-end collisions at signalized intersections
- Left-turn collisions at intersections
- Right-turn collisions at intersections
- Pedestrian accidents at intersections
- Pedestrian accidents at locations between intersections
- Fixed object collisions
- Fixed object collisions and/or vehicles running off road
- Sideswipe or head-on collisions between vehicles traveling opposite directions
- Lane change, sideswipe or turning collisions between vehicles traveling in the same direction
- Collisions with parked vehicles or vehicles being parked
- Collisions at driveways
- Pedestrian accidents at driveways
- Wet pavement accidents
- Night accidents
- Collisions at railroad grade crossings

REFERENCES

1. "Local Highway Safety Studies - User's Guide," Federal Highway Administration, July 1986.
2. "Highway Safety Engineering Studies - Procedural Guide," Federal Highway Administration, Report No. FHWA-TS-81-220, November 1981.
3. P. Box, "Accident Pattern Evaluation and Countermeasures," Traffic Engineering, pp. 38-43, August 1976.

Source: **Manual on Identification, Analysis and Correction of High-Accident Locations**, 1990, University of Missouri—Rolla for MO Technology Transfer Center/Missouri Highway and Transportation Department

TABLE B-1. GENERAL COUNTERMEASURES FOR ACCIDENT PATTERNS AND THEIR PROBABLE CAUSES.

ACCIDENT PATTERN	PROBABLE CAUSE	GENERAL COUNTERMEASURE
Right-angle collisions at unsignalized intersections	Restricted sight distance	Remove sight obstructions Restrict parking near corners Install warning signs * Install yield signs * Install stop signs * Install overhead flashing beacon * Channelize intersection Reconstruct approach to improve crossing angle at intersection Install/improve street lighting Install signals * Reduce speed limit on approaches **
	Large total traffic volume at location	Install stop signs * Install signals * Add traffic lanes Reroute through traffic
	High approach speed	Reduce speed limits on approaches ** Install rumble strips Install overhead flashing beacon *
Right-angle collisions at signalized intersections	Restricted sight distance	Remove sight obstructions Restrict parking near corners Install warning signs * Reduce speed limit on approaches **
	Poor visibility of traffic signals	Remove sight obstructions Install 12-inch signal lenses * Install signal visors or back plates Install advance warning devices * Install overhead or added signals * Reduce speed limit on approaches **
	Inadequate traffic signal timing or type of signal	Adjust yellow change interval Provide all-red clearance interval Adjust phase times and cycle time Install multi-dial controller Install traffic actuated signal Adjust minimum green or extension time Provide/improve progression through a set of signalized intersections Install signal speed sign *

* Refer to Manual on Uniform Traffic Control Devices for proper application and warrants.

** Spot speed study should be conducted to justify speed limit reduction.

TABLE B-1 (Cont'd). GENERAL COUNTERMEASURES FOR ACCIDENT PATTERNS AND THEIR PROBABLE CAUSE.

ACCIDENT PATTERN	PROBABLE CAUSE	GENERAL COUNTERMEASURE
Rear-end collisions at unsignalized intersections	Pedestrians crossing roadway	Improve crosswalk markings and/or signs* Illuminate crosswalk Relocate crosswalk
	Driver not aware of intersection	Install/improve warning signs * Install overhead flashing beacon *
	Slippery surface	Overlay pavement (friction course) Chip and seal or slurry seal approaches Groove pavement Provide adequate drainage and/or crown Reduce speed limit on approaches ** Use "SLIPPERY WHEN WET" sign (temporary)*
	Large volume of vehicles turning	Increase curb radii Construct left-turn or right-turn lanes Prohibit turns
Rear-end collisions at signalized intersections	Poor visibility of traffic signals	Remove sight obstructions Install/improve advance warning devices Install 12-inch signal lenses * Install signal visors and/or back plates Install additional/overhead signals * Reduce speed limits on approaches **
	Inadequate traffic signal timing	Adjust yellow change interval Provide all-red clearance interval Adjust phase time and cycle time Install multi-dial controller Install traffic-actuated signal Adjust minimum green or extension time Provide/improve signal progression
	Pedestrians crossing roadway	Improve crosswalk markings/signs * Provide pedestrian "WALK" phases Improve/install lighting at crosswalks
	Slippery surface	Overlay pavement (friction course) Chip and seal or slurry seal approaches Groove pavement Provide adequate drainage and/or crown Reduce speed limit on approaches ** Use "SLIPPERY WHEN WET" sign (temporary)*
	Unwarranted signals	Remove signals *
	Large volume of vehicles turning	Increase curb radii Construct left-turn or right-turn lanes Prohibit turns

* Refer to Manual on Uniform Traffic Control Devices for proper application and warrants.

** Spot speed study should be conducted to justify speed limit reduction.

TABLE B-1 (Cont'd). GENERAL COUNTERMEASURES FOR ACCIDENT PATTERNS AND THEIR PROBABLE CAUSE.

ACCIDENT PATTERN	PROBABLE CAUSE	GENERAL COUNTERMEASURE
Left-turn collisions at intersections	Large volume of left-turn traffic	Channelize intersection Install "STOP" signs * Provide signal with left-turn phase * Reroute left-turn traffic Prohibit left-turns Create one-way streets
	Restricted sight distance	Remove sight obstructions Install warning signs * Reduce speed limit on approaches **
Right-turn collisions at intersections	Inadequate turning path	Increase curb radii
	Restricted sight distance	Remove sight obstructions Add "NO TURN ON RED" signs if signalized* Reduce speed limit on approaches **
Pedestrian accidents at intersections	Sight distance inadequate	Remove sight obstructions Improve/install pedestrian crossings * Improve/install pedestrian crossing signs * Reroute pedestrian path/mid-block crossing
	Inadequate protection for pedestrians	Add pedestrian refuge islands Install pedestrian signals * Install pedestrian overpass or underpass
	Inadequate traffic signals	Add pedestrian "WALK" phase * Improve timing of pedestrian phase
	School crossing area	Remove parking from crosswalk location Remove sight obstructions Install school zone markings * Install school crossing signs * Install school speed limit signs * Install school crossing signals * Use school crossing guards Revise school route plan map * Construct overpass or underpass
Pedestrian accidents at locations between intersections	Driver has inadequate warning of frequent mid-block crossings	Prohibit parking Install warning signs * Reduce speed limit **
	Pedestrians walking on road or jay-walking	Install sidewalks Install "CROSS ONLY AT CROSSWALK" signs * Install pedestrian barriers
	Distance too long to nearest crosswalk	Install additional crosswalks and signs * Install pedestrian actuated signals *

* Refer to Manual on Uniform Traffic Control Devices for proper application and warrants.

** Spot speed study should be conducted to justify speed limit reduction.

TABLE B-1 (Cont'd). GENERAL COUNTERMEASURES FOR ACCIDENT PATTERNS AND THEIR PROBABLE CAUSE.

ACCIDENT PATTERN	PROBABLE CAUSE	GENERAL COUNTERMEASURE
Fixed object collisions	Objects located too near the roadway	Remove or relocate large objects Install object marker * Modify poles/posts with breakaway feature Eliminate poles by burying utility lines Install barrier curbs or guardrail
Fixed object collisions and/or vehicles running off road	Slippery pavement	Overlay pavement (friction course) Chip and seal or slurry seal approaches Groove pavement surface Provide adequate drainage or improve crown Reduce speed limit ** Use "SLIPPERY WHEN WET" sign (temporary)*
	Roadway design is no longer adequate for traffic conditions	Widen lanes and/or shoulders Relocate or remove islands Flatten side slopes Provide proper superelevation on curve Construct more gradual horizontal curve
	Poor delineation	Improve/install pavement markings Install roadside delineators or chevron alignment signs *
	Driver has inadequate warning of roadway alignment change	Install curve or turn warning sign * Install advisory speed plate on curve or turn warning sign * Install large arrow warning sign *
Sideswipe or head-on collisions between vehicles traveling opposite directions	Roadway design is no longer adequate for traffic conditions	Install/improve center line markings * Channelize intersections Widen lanes and/or shoulders Remove constriction as parked vehicles Install median divider Create one-way streets
Lane change, sideswipe or turning collisions between vehicles traveling in the same direction	Roadway design is no longer adequate for traffic conditions	Widen lanes and/or shoulders Remove constrictions as parked vehicles Channelize intersections Provide turning bay for high volume driveway Install continuous two-way left-turn lane Reduce speed limit **
	Inadequate traffic control devices	Improve/install pavement lane lines * Install advance route identification or street name signs *

* Refer to Manual on Uniform Traffic Control Devices for proper application and warrants.

** Spot speed study should be conducted to justify speed limit reduction.

TABLE B-1 (Cont'd). GENERAL COUNTERMEASURES FOR ACCIDENT PATTERNS AND THEIR PROBABLE CAUSE.

ACCIDENT PATTERN	PROBABLE CAUSE	GENERAL COUNTERMEASURE
Collisions with parked vehicles or vehicles being parked	High rate of parking turnover	Change from angle to parallel parking Provide short-term off-street parking Prohibit parking Restrict parking during rush hours Reroute through traffic Create one-way streets
	Roadway design is not adequate for traffic conditions	Widen lanes Change from angle to parallel parking Prohibit parking Restrict parking during rush hours Reroute through traffic Reduce speed limit on traveled way *
Collisions at driveways	Improperly located driveway	Regulate minimum spacing of driveways Regulate minimum corner clearance Move driveway to side street Combine adjacent driveways
	Left-turn vehicles	Install median divider Install continuous two-way left-turn lane Install protected left-turn bays
	Right-turn vehicles	Provide right-turn lanes Restrict parking near driveways Increase driveway width Widen through lanes Increase driveway curb radii
	Large volume of through traffic	Move driveway to side street Construct a local service road Reroute through traffic
	Large volume of driveway traffic	Signalize driveway Provide acceleration and/or deceleration lanes Widen and/or channelize driveway Construct additional driveway Change to one-way driveways
	Inadequate sight distance	Remove sight obstructions Restrict parking near driveway Install/improve lighting at driveway Reduce speed limit*
Pedestrian accidents at driveways	Sidewalk too close to roadway	Move sidewalk laterally away from street

* Spot speed study should be conducted to justify speed limit reduction.

TABLE B-1 (Cont'd). GENERAL COUNTERMEASURES FOR ACCIDENT PATTERNS AND THEIR PROBABLE CAUSE.

ACCIDENT PATTERN	PROBABLE CAUSE	GENERAL COUNTERMEASURE
Wet pavement accidents	Slippery pavement	Overlay pavement (friction course) Chip and seal or slurry seal roadway Groove pavement surface Reduce speed limit ** Use "SLIPPERY WHEN WET" sign (temporary)*
	Water ponding on roadway	Provide adequate drainage Improve roadway crown Remove turf or other drainage impediments from shoulder
	Inadequate pavement markings	Install raised/reflectorized pavement markers
Night accidents	Poor visibility	Improve/install street lighting Improve/install reflectorized signs Improve/install reflectorized pavement markers Remove distracting commercial lighting or other sources of glare
Collisions at railroad grade crossings	Inadequate sight distance	Remove sight obstructions Improve/install advance warning signs * Improve/install pavement markings * Install train actuated signals * Install overhead flashing lights * Install automatic crossing gates * Reconstruct crossing to provide improved crossing angle Construct grade separation
	Poor visibility	Improve/install crossing lighting Install larger reflectorized signs
	Slippery approaches	Improve drainage Install skid resistant surface
	Excessive speed	Reduce speed limits on approaches ** Reduce train speed through community

* Refer to Manual on Uniform Traffic Control Devices for proper application and warrants.
** Spot speed study should be conducted to justify speed limit reduction.

Pedestrian Crash Counter-Measures

COUNTERMEASURES ASSOCIATED WITH

CRASH TYPE GROUP	A. Pedestrian Facility Design	B. Roadway Design	C. Intersection Design
1. Dart/Dash	• Crosswalk Enhancements • Transit Stop Treatments • Roadway Lighting • Overpass/Underpass • Steet Furniture	• Bike Lane/Shoulder • Road/Lane Narrowing • Raised Median	
2. Multiple Threat / Trapped	• Crosswalk Enhancements • Transit Stop Treatments • Roadway Lighting • Overpass/Underpass	• Bike Lane/Shoulder • Road/Lane Narrowing • Fewer Lanes • Raised Median	• Intersection Median Barrier
3. Unique Midblock (mailbox, ice cream vendor, parked vehicles)	• Roadway Lighting	• Bike Lane/Shoulder • Road/Lane Narrowing • Raised Median	
4. Through Vehicle at Unsignalized Location	• Curb Ramp • Crosswalk Enhancements • Transit Stop Treatments • Roadway Lighting • Overpass/Underpass	• Bike Lane/Shoulder • Road/Lane Narrowing • Fewer Lanes • Raised Median • Smaller Curb Radius	• Intersection Median Barrier
5. Bus-Related	• Sidewalk/Walkway • Curb Ramps • Crosswalk Enhancements • Transit Stop Treatments • Roadway Lighting • Street Furniture	• Bike Lane/Shoulder • Fewer Lanes	
6. Turning Vehicle	• Curb Ramp • Crosswalk Enhancements • Transit Stop Treatments • Roadway Lighting • Overpass/Underpass	• Raised Median • One-way Street • Smaller Curb Radius • Right-Turn Slip Lane	• Modern Roundabout • Modified T-Intersection • Intersection Median Barrier

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SPECIFIC CRASH TYPE GROUPS

D. Traffic Calming	E. Traffic Management	F. Signals and Signs	G. Other Measures
• Curb Extension • Choker • Pedestrian Crossing Island • Chicane • Speed Humps • Speed Table • Raised Pedestrian Crossing • Gateway • Driveway Link/Serpentine • Woonerf	• Diverter • Full Street Closure • Partial Street Closure • Pedestrian Street	• Traffic Signal • Pedestrian Signal • Signal Enhancement • Sign Improvement	• School Zone Improvement • Identify Neighborhood • Speed-Monitoring Trailer • Parking Enhancement • Ped./Driver Education • Police Enforcement
• Curb Extension • Pedestrian Crossing Island • Speed Table • Raised Pedestrian Crossing		• Traffic Signals • Pedestrian Signal • Advanced Stop Lines • Sign Improvement	• School Zone Improvement • Ped./Driver Education • Police Enforcement
• Chicane • Speed Humps • Speed Table • Gateway		• Sign Improvement	• Identify Neighborhood • Speed-Monitoring Trailer • Parking Enhancement • Ped./Driver Education • Police Enforcement
• Curb Extension • Choker • Pedestrian Crossing Island • Chicane • Speed Humps • Speed Table • Raised Intersection • Raised Pedestrian Crossing • Gateway • Landscape Options • Paving Treatments • Driveway Link/Serpentine	• Pedestrian Street	• Traffic Signals • Pedestrian Signal • Sign Improvement	• School Zone Improvement • Identify Neighborhood • Speed-Monitoring Trailer • Parking Enhancement • Ped./Driver Education • Police Enforcement
• Curb Extension • Pedestrian Crossing Island • Raised Pedestrian Crossing		• Traffic Signal • Pedestrian Signal • Advanced Stop Lines • Sign Improvement	• School Zone Improvement • Parking Enhancement • Ped./Driver Education • Police Enforcement
• Curb Extension • Pedestrian Crossing Island • Mini-Circle • Raised Intersection • Raised Pedestrian Crossing • Paving Treatments	• Diverter • Full Street Closure • Partial Street Closure	• Traffic Signals • Pedestrian Signal • Pedestrian Signal Timing • Signal Enhancement • RTOR Restriction • Advanced Stop Lines • Sign Improvement	• School Zone Improvement • Parking Enhancement • Ped./Driver Education • Police Enforcement

COUNTERMEASURES ASSOCIATED WITH

CRASH TYPE GROUP	A. Pedestrian Facility Design	B. Roadway Design	C. Intersection Design
7. Through Vehicle At Signalized Location	• Curb Ramp • Crosswalk Enhancements • Transit Stop Treatments • Roadway Lighting • Overpass/Underpass	• Raised Median • One-way Street	• Modern Roundabout • Intersection Median Barrier
8. Walking Along Roadway	• Sidewalk/Walkway • Curb Ramp • Roadway Lighting • Street Furniture	• Bike Lane/Shoulder • Road/Lane Narrowing • Fewer Lanes	
9. Working/Playing In Road	• Sidewalk/Walkway • Roadway Lighting	• Bike Lane/Shoulder • Road/Lane Narrowing	
10. Non-Roadway (sidewalk, driveway, parking lot, or other)	• Sidewalk/Walkway • Roadway Lighting	• Bike Lane/Shoulder • Driveway Improvement • Smaller Curb Radius	
11. Backing Vehicle	• Sidewalk/Walkway • Roadway Lighting	• Driveway Improvement	
12. Crossing Expressway	• Roadway Lighting • Overpass/Underpass		

SPECIFIC CRASH TYPE GROUPS

D. Traffic Calming	E. Traffic Management	F. Signals and Signs	G. Other Measures
• Curb Extension • Pedestrian Crossing Island • Mini-Circle • Raised Intersection • Raised Pedestrian Crossing • Paving Treatments	• Diverter • Full Street Closure • Partial Street Closure	• Traffic Signal • Pedestrian Signal • Pedestrian Signal Timing • Signal Enhancement • Advanced Stop Lines • Sign Improvement • Police Enforcement	• School Zone Improvement • Speed-Monitoring Trailer • Parking Enhancement • Ped./Driver Education
		• Sign Improvement	• School Zone Improvement • Identify Neighborhood • Speed-Monitoring Trailer • Ped./Driver Education • Police Enforcement
• Chicane • Mini-Circle • Speed Humps • Speed Table • Gateway • Driveway Link/Serpentine • Woonerf	• Diverter • Full Street Closure • Partial Street Closure • Pedestrian Street	• Sign Improvement	• Identify Neighborhood • Speed-Monitoring Trailer • Ped./Driver Education • Police Enforcement
• Curb Extension • Landscape Options		• Sign Improvement	• School Zone Improvement • Parking Enhancement • Ped./Driver Education • Police Enforcement
• Curb Extension • Raised Pedestrian Crossing • Landscape Options			• Parking Enhancement • Ped./Driver Education
		• Sign Improvement	• Ped./Driver Education • Police Enforcement

COUNTERMEASURES ASSOCIATED WITH

OBJECTIVE	A. Pedestrian Facility Design	B.Roadway Design	C.Intersection Design
1. Reduce Speed of Motor Vehicles	• Street Furniture*	• Add Bike Lane/Shoulder • Road Narrowing • Reduce Number of Lanes • Driveway Improvements • Curb Radius Reduction • Right-Turn Slip Lane	• Modern Roundabouts
*To be used in conjunction with other treatments			
2. Improve Sight Distance and Visibility for Motor Vehicles and Pedestrians	• Crosswalk Enhancements • Roadway Lighting • Move Poles/Newspaper Boxes at Street Corners	• Add Bike Lane/Shoulder	
3. Reduce Volume of Motor Vehicles		• Reduce Number of Lanes	
4. Reduce Exposure for Pedestrians	• Overpasses/Underpasses	• Road Narrowing • Reduce Number of Lanes • Raised Median • Pedestrian Crossing Island	
5. Improve Pedestrian Access and Mobility	• Sidewalk/Walkway • Curb Ramps • Crosswalk Enhancements • Transit Stop Treatments • Overpasses/Underpasses	• Raised Median	
6. Encourage Walking by Improving Aesthetics	• Street Furniture • Roadway Lighting • Landscaping Options	• Raised Median	
7. Improve Compliance With Traffic Laws			• Red-Light Cameras
8. Eliminate Behaviors That Lead to Crashes			• Red-Light Cameras

SPECIFIC PERFORMANCE OBJECTIVES

D. Traffic Calming	E. Traffic Management	F. Signals and Signs	G.Other Measures
• Curb Extension • Choker • Chicane • Mini-Circle • Speed Humps • Speed Table • Raised Pedestrian Crossing • Raised Intersection • Driveway Link/Serpentine • Woonerf • Landscaping Options* • Paving Treatments*		• Signal Enhancement (e.g., Adjust Signal Timing for Motor Vehicles) • Sign Improvement*	• Speed-Monitoring Trailer • School Zone Improvement
• Curb Extension • Speed Table • Raised Pedestrian Crossing • Raised Intersection • Paving Treatments		• Sign Improvement (e.g., Warning Sign) • Advanced Stop Lines	
• Woonerf	• Diverters • Full Street Closure • Partial Street Closure • Pedestrian Street		
• Curb Extension • Choker • Pedestrian Crossing Island		• Pedestrian Signal Timing • Accessible Pedestrian Signal	
• Choker • Pedestrian Crossing Island		• Traffic Signal • Signal Enhancement • Accessible Pedestrian Signal • Pedestrian Signal Timing	
• Gateway • Landscaping • Paving Treatments			• Identify Neighborhood
• Traffic Calming: Choker, Chicane, Mini-Circle, Speed Hump, Speed Table			• Speed-Monitoring Trailer • Pedestrian/Driver Education • Police Enforcement
• Traffic Calming: Choker, Chicane, Mini-Circle, Speed Hump, Speed Table		• Pedestrian Signal Timing	• Pedestrian/Driver Education • Police Enforcement

APPENDIX B - AUTOMATIC TRAFFIC COUNTERS

Traffic Volume Count

MCDOT uses two channel pneumatic tube counters in a "half tube" two directional configuration. The "long" tube is laid across the lanes in both directions; the "short" tube across one direction. The long and short tubes are about one to one and one half foot apart. The counter does the math internally to separate the directions based on which tube(s) are hit. The counter is set up for 15 minute intervals and is normally left out for at least 48 hours on weekdays. Weekday traffic is the usual benchmark for traffic volumes.

The traffic volume data is entered into a traffic summary database that is distributed internally within the County, the City of Rochester, the State, and engineering consultants. Data entered into the summary includes Average Daily Traffic, Two Way Peak Hour Traffic, One Way Peak Hour Traffic (highest direction within the two way peak), and Peak Hour Factor. That data is averaged over the complete days counted, usually Tuesday through Thursday.

Speed Count

Speeds are grouped into five MPH "bins" from less than 15 MPH to over 70 MPH. Speed counts are taken with two-channel pneumatic tube counters with the tubes placed eight feet apart across either one lane in one direction or two lanes in opposite directions. Multi-lane counts in the same direction cannot be done accurately. Counts on higher volume roads should be taken with separate counters for each direction. The counter(s) are set up for 15 minute intervals and are normally left out for at least 48 hours on weekdays. Weekday traffic is the usual benchmark for traffic speeds. The primary statistics used by MCDOT are the eighty-fifth percentile speed, the ten MPH pace, and the percent over the speed limit.

Vehicle Class Count

MCDOT classifies vehicles based on axle count according to the 13 classifications in FHWA Scheme F. Vehicle class counts are taken with two-channel pneumatic tube counters with the tubes placed eight feet apart across either one lane in one direction or two lanes in opposite directions. Multi-lane counts in the same direction cannot be done accurately. Counts on higher volume roads should be taken with separate counters for each direction. The counter(s) are set up for 15 minute intervals and are normally left out for at least 48 hours on weekdays. Weekday traffic is the usual benchmark for vehicle class counts.

NODE 101833
WEGMAN RD.
LYELL RD.S.OF
CHAN A=SB,CHAN B=NB

Monroe County
Dept. of Transportation
Traffic Engineering

Site Code : 000010183351
Start Date: 05/16/2005
File I.D. : 101833
Page : 2

Begin	Wed.	1		2		Combined		Thur.	1		2		Combined	
Time	05/18	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.	05/19	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
12:00		5	64	14	96	19	160		10	62	7	89	17	151
12:15		5	93	3	84	8	177		8	77	6	69	14	146
12:30		6	67	6	103	12	170		3	65	1	72	4	137
12:45		8	96	2	67	10	163		2	80	6	82	8	162
01:00		3	75	2	87	5	162		3	100	10	67	13	167
01:15		2	65	2	81	4	146		6	89	4	68	10	157
01:30		2	76	3	93	5	169		4	87	2	87	6	174
01:45		2	86	0	112	2	198		1	70	1	81	2	151
02:00		2	81	4	95	6	176		1	86	5	92	6	178
02:15		0	86	2	116	2	202		3	78	7	142	10	220
02:30		0	112	4	124	4	236		0	98	7	119	7	217
02:45		3	102	1	91	4	193		6	115	24	112	30	227
03:00		0	111	1	137	1	248		1	104	15	114	16	218
03:15		3	94	2	136	5	230		2	92	7	97	9	189
03:30		0	101	2	123	2	224		4	104	4	118	8	222
03:45		0	100	0	117	0	217		4	96	2	108	6	204
04:00		2	88	2	114	4	202		3	87	4	109	7	196
04:15		4	92	3	105	7	197		0	103	1	114	1	217
04:30		4	95	3	124	7	219		5	80	4	109	9	189
04:45		7	85	3	86	10	171		5	95	5	137	10	232
05:00		7	105	3	111	10	216		4	86	4	102	8	188
05:15		4	101	6	132	10	233		6	111	4	120	10	231
05:30		11	112	9	110	20	222		11	92	12	113	23	205
05:45		27	127	23	95	50	222		25	97	12	94	37	191
06:00		31	116	14	139	45	255		26	142	23	128	49	270
06:15		18	95	21	112	39	207		19	116	20	116	39	232
06:30		39	108	27	95	66	203		32	104	29	89	61	193
06:45		82	106	42	91	124	197		85	105	39	77	124	182
07:00		147	77	38	71	185	148		138	81	37	88	175	169
07:15		120	55	65	79	185	134		115	88	75	59	190	147
07:30		103	69	64	87	167	156		106	66	77	91	183	157
07:45		156	72	64	78	220	150		145	80	53	68	198	148
08:00		91	58	62	74	153	132		118	75	95	139	213	214
08:15		71	77	48	95	119	172		82	63	61	113	143	176
08:30		68	53	53	56	121	109		80	55	62	57	142	112
08:45		106	47	90	76	196	123		83	58	73	59	156	117
09:00		69	49	64	59	133	108		74	35	63	57	137	92
09:15		51	42	68	47	119	89		48	51	71	41	119	92
09:30		69	36	57	47	126	83		67	33	65	59	132	92
09:45		65	35	82	50	147	85		62	40	60	47	122	87
10:00		66	29	74	23	140	52		72	23	71	29	143	52
10:15		73	16	51	18	124	34		72	22	72	20	144	42
10:30		72	25	75	20	147	45		71	15	75	22	146	37
10:45		56	18	95	23	151	41		72	17	78	22	150	39
11:00		65	17	59	24	124	41		56	22	78	22	134	44
11:15		71	19	70	17	141	36		63	13	81	16	144	29
11:30		77	13	70	13	147	26		70	7	82	22	152	29
11:45		82	21	87	11	169	32		79	8	87	12	166	20
Totals		1955	3467	1540	3944	3495	7411		1952	3473	1681	3868	3633	7341
Day Totals			5422		5484		10906			5425		5549		10974
% Total		17.9%	31.7%	14.1%	36.1%				17.7%	31.6%	15.3%	35.2%		
Peaks		07:00	05:15	10:30	03:00	07:00	05:15		07:00	06:00	11:00	02:15	07:15	05:30
Volume		526	456	299	513	757	932		504	467	328	487	784	898
P.H.F.		.84	.89	.78	.93	.86	.91		.86	.82	.94	.85	.92	.83

Automatic Traffic Counter Volume Count Report

Monroe County Dept. of Trans.
SPEED SUMMARY
WED 04/12/2006

Page: 3

Site Reference: 000000219874
Site ID: 000000000730
Location: Bulls Saw Mill Rd, W/O Chamberlain Rd
Direction: EAST
Lane: 1

File: 219874.prn
City: Mendon
County: Monroe

TIME	10	15	20	25	30	35	40	45	50	55	60	65	70	71+	Total
01:00	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
02:00	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:00	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
07:00	0	0	0	0	0	0	0	1	1	0	0	0	0	0	2
08:00	0	0	0	0	0	0	1	1	1	2	0	2	0	0	7
09:00	0	0	0	0	0	0	0	4	6	3	0	0	0	0	13
10:00	0	0	1	0	1	0	0	2	5	4	1	0	0	0	14
11:00	0	0	0	1	0	0	3	0	1	2	1	0	0	0	8
12:00	0	0	0	0	0	0	0	4	2	0	0	0	0	0	6
13:00	0	0	0	0	1	0	0	4	4	4	0	2	0	0	15
14:00	0	0	0	0	0	1	1	3	3	2	1	0	1	0	12
15:00	0	0	0	1	0	1	3	0	2	3	1	1	0	0	12
16:00	0	0	0	0	0	2	0	5	5	4	2	0	0	0	18
17:00	0	0	0	0	0	1	1	3	8	7	3	1	0	0	24
18:00	0	0	0	1	0	0	2	5	14	3	2	3	1	0	31
19:00	0	0	0	0	0	0	2	7	4	3	0	2	0	0	18
20:00	0	0	0	1	0	0	2	5	4	0	0	0	0	0	12
21:00	0	0	0	0	0	0	0	4	4	1	1	0	0	0	10
22:00	0	0	0	0	0	0	4	2	2	0	0	0	0	0	8
23:00	0	0	0	0	1	1	0	1	1	0	0	0	0	0	4
24:00	0	0	0	0	0	0	1	1	1	0	0	0	0	0	3
DAY TOTAL	0	0	2	4	3	6	21	52	69	38	12	11	2	0	220
PERCENTS	0.0%	0.0%	1.0%	1.9%	1.4%	2.8%	9.5%	23.6%	31.3%	17.2%	5.4%	5.0%	0.9%	0.0%	100%

Statistical Information...

15th Percentile Speed
39.3 Mph

Median Speed
46.6 Mph

10 MPH Pace Speed
40MPH to 50MPH
121 vehicles in pace
Representing 55% of the total vehicles

85th Percentile Speed
54.0 Mph

Average Speed
46.3 Mph

Vehicles > 55 MPH
25
11.3%

Automatic Traffic Counter Speed Data Report

Monroe County Dept. of Trans.
CLASSIFICATION SUMMARY
WED 06/21/2006

Page: 2

Site Reference: 000000208804
Site ID: 000000000734
Location: Stone Rd @ #460, E/O Candlewood Dr
Direction: EAST
Lane: 1

File: 208804clseb.prn
City: Pittsford
County: Monroe

TIME	Motor cycle	Cars/ 2Axlo	Buses 2Ax6t	3AxSi	4AxSi	<5AxD	5AxDo	>5AxD	<6AxM	6AxMu	>6AxM	Total
01:00	0	13	0	0	0	0	0	0	0	0	0	13
02:00	0	9	0	0	0	0	0	0	0	0	0	9
03:00	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	5	0	0	0	0	0	0	0	0	0	5
05:00	0	3	0	0	0	0	0	0	0	0	0	3
06:00	0	7	0	0	0	0	0	0	0	0	0	7
07:00	0	42	5	0	0	1	0	0	0	0	0	48
08:00	0	81	17	0	1	2	0	0	2	0	0	103
09:00	0	98	26	1	3	3	0	0	0	0	0	131
10:00	0	84	15	0	1	4	1	0	1	0	0	106
11:00	1	115	19	0	1	5	0	0	0	0	0	141
12:00	0	147	20	2	3	3	0	0	0	0	0	175
13:00	0	173	15	0	0	4	0	0	0	0	0	192
14:00	1	135	17	0	2	3	0	0	1	0	0	159
15:00	1	162	19	0	1	4	0	0	0	0	0	187
16:00	2	182	26	2	3	2	0	0	0	0	0	217
17:00	1	258	26	1	1	0	0	0	0	0	0	287
18:00	1	317	16	0	0	0	0	0	0	1	0	335
19:00	1	173	11	3	0	0	0	0	0	0	0	188
20:00	1	142	5	0	0	0	1	0	0	0	0	149
21:00	0	83	6	0	0	0	0	0	0	0	0	89
22:00	0	65	4	1	1	0	0	0	0	0	0	71
23:00	0	52	0	0	0	0	0	0	0	0	0	52
24:00	0	21	2	0	0	0	0	0	0	0	0	23
DAY TOTAL	9	2367	249	10	17	31	1	1	4	0	0	2690
PERCENTS	0.4%	88.0%	9.3%	0.4%	0.7%	1.1%	0.0%	0.0%	0.1%	0.0%	0.0%	100%
Passenger Vehicles		97.5%						Trucks & Buses		2.4%		
AM Times	10:15	11:15	08:15	10:45	08:15	08:45	08:30		07:15			11:15
AM Peaks	1	147	26	2	3	5	1		2			175
PM Times	13:30	17:00	15:30	15:45	14:00	11:30		19:00	13:15		17:00	17:00
PM Peaks	2	345	30	3	3	4		1	1		1	366

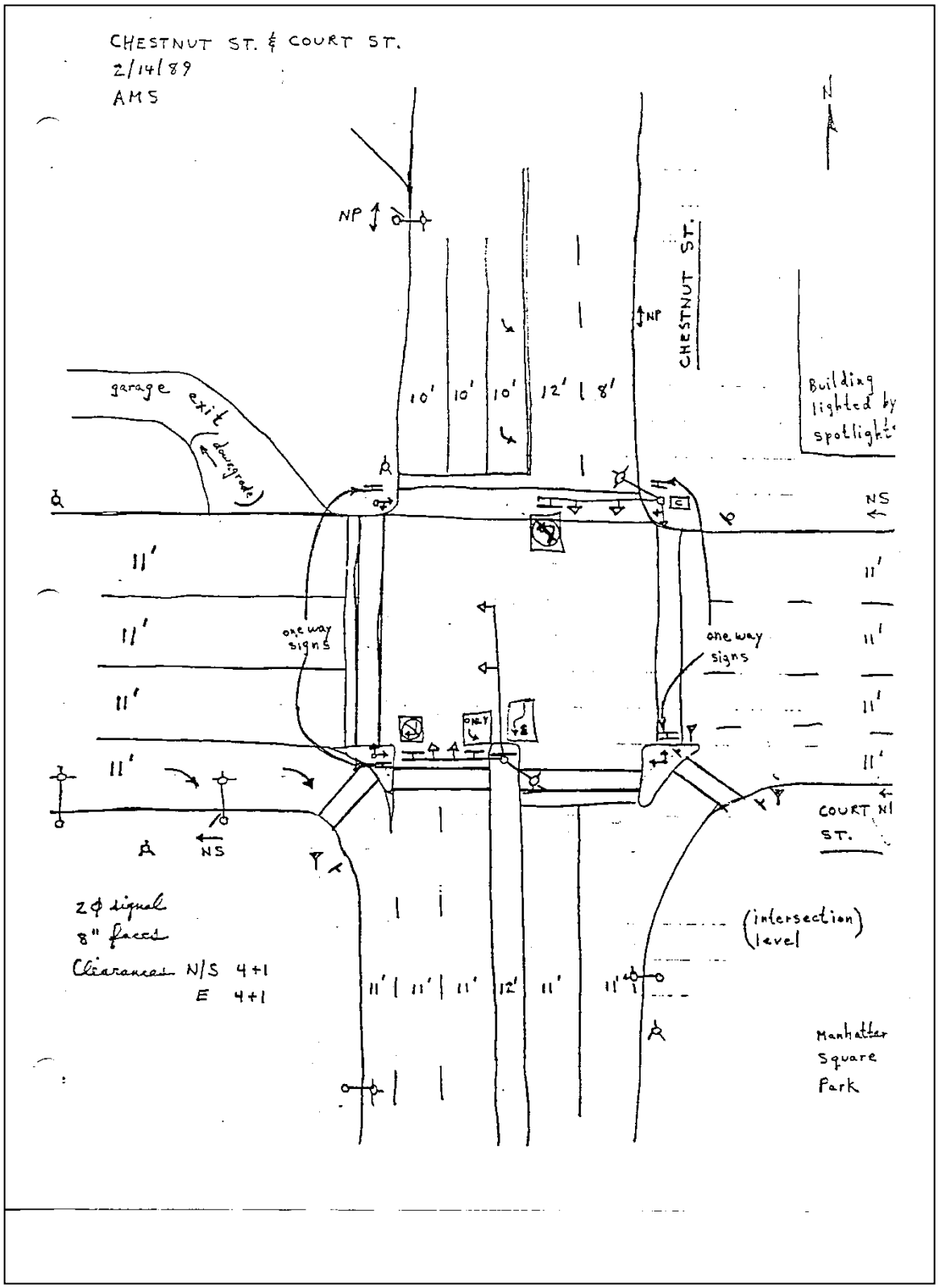
Automatic Traffic Counter Vehicle Class Report

APPENDIX C - CONDITION SURVEY FIELD REVIEW/SKETCH

A condition study or condition diagram is a sketch of the area under study. It shows existing geometrics, traffic control devices, signing and sight distance at approaches.

IMPORTANT THINGS TO SKETCH:

- number, assignment, and width of all approach lanes
- parking regulations, type and placement of signs
- devices that control right-of-way such as Stop/Yield signs or signals (include pedestrian signals)
- Speed limit signs, regulatory and advisory
- All warning signs, such as curve signs and blind driveway signs
- sidewalks and/or wheelchair ramps
- indicate shoulder width and type (paved, unpaved or grass) and curbs
- pavement markings such as crosswalks, stop bars, and striping
- measure curb extension to the back of the sidewalk
- sight distance to the right and left for all Stop/Yield controlled approaches
- placement of overhead lighting
- All other signing such as school zone/crossing signs, pedestrian signs, “Stop Ahead”, intersection ahead, etc.
- All other characteristics that may be relevant to the study



Condition Survey Field Review Sketch

APPENDIX D - CURVE ADVISORY SPEED BALL BANK SURVEY

The advisory speed on curves, as per the NYS Supplement to the National MUTCD, is determined by the use of a ball-bank indicator. The ball-bank indicator is used to determine the advisory speed as per the table below. For example, if the proper advisory speed is 35 MPH, the ball-bank indicator should read 12 degrees.

SPEED (MPH)	BALL BANK READING (degrees)
<= 24	16
25 – 34	14
35 – 49	12
>= 50	10

Advisory speed determinations should be made on dry pavement only. Traffic, the speedometer, and the ball-bank indicator must be watched, and therefore, it is preferable that two men be employed. Before making speed determinations, the ball-bank indicator should be checked to make sure that the ball is at zero while the car is on a surface which is level transversely and loaded as it will be loaded when the speed determination is made. In order to obtain a true reading on the ball-bank indicator, the car must be driven parallel with the center line of the curve, in other words, the common practice of flattening out the curve by driving on the inside of the curve at the center should not be followed.

The curve should be run a number of times until at least three readings for each direction of travel are obtained which are essentially the same. Each direction of travel should be considered separately.

Ball Bank Curve Speed Study

Road Name: _____ Date: _____

Closest Intersection: _____

Driving Direction: _____ Time: _____ Weather: _____

Distance it Intersection/ Mile marker: _____ By: _____

	Ball Bank Reading	
Speed Driven (mph)	**Maximum Allowed (degrees)**	**Recorded reading (degrees)**
15	16°	
20	16°	
25	14°	
30	14°	
35	12°	
40	12°	
45	12°	
50	10°	
55	10°	
60	10°	

Advisory Speed: _____mph

Posted Speed Limit: _____mph

Note: If the Advisory speed is less than the Posted Speed Limit, an advisory speed plate is required.

W13-1

# of Curves	Advisory Speed (mph)		
	Less than or equal 20 mph	**25 or 30 mph**	**Greater than or equal 35 mph**
1	W1-1 	Turn or Curve signs may be used.*	W1-2 
2	W1-3 		W1-4 
3 or more	W1-5 		

* The decision should be based on the geometry and general appearance of the particular curve(s)

Recommended Sign (s): _____

Curve Advisory Determination – Ball Bank Survey Single Curve

BALL BANK WORKSHEET

Road Name: _____
Municipality: _____

Date/Time: _____
Driver: _____
Observer: _____
Vehicle: _____
Weather: _____
Surface condition: _____

Speed Limit: _____

Speed Range	Maximum Ball Bank Reading
≤ 24 mph	16 degrees
25-34 mph	14 degrees
35-49 mph	12 degrees
≥ 50 mph	10 degrees

# of Curves	Advisory Speed (mph)		
	Less than or equal 20 mph	25 or 30 mph	Greater than or equal 35 mph
1	W1-1 L R	Turn or Curve signs may be used.*	W1-2 L R
2	W1-3 L R		W1-4 L R
3 or more	W1-5 L		R

XX MPH
W13-1

* The decision should be based on the geometry and general appearance of the particular curve(s)

Curve No.	Existing Advisory Speed (mph)	Driving Direction	Recorded Ball Bank Reading Speed, (mph)										New Advisory Speed (mph)
			15	20	25	30	35	40	45	50	55	60	

Curve Advisory Determination – Ball Bank Survey Multiple Curves

APPENDIX E – GAP ANALYSIS SURVEY

A gap is an opening or break in one-way or two-way traffic whereby vehicles or pedestrians have an opportunity to enter/cross the traffic stream. Gaps are measured in seconds between the arrivals of successive vehicles in either direction at a specific location. This information is used to help determine if additional traffic control devices are needed (ie - in the case of a school crossing, an adult crossing guard).

An acceptable gap for pedestrians to cross is defined as follows:

minimum acceptable gap time = [(pavement width)/ (walking speed)] + [perception/reaction time]

pavement width = width in feet between the outer edge of the travel lanes being crossed

walking speed = 3.5 feet/sec, possibly less if primarily used by elderly or handicapped pedestrians

perception/reaction time = 5.0 seconds

A stop watch is used to measure the gaps and a recording sheet is used to document the gaps equal to or greater than the minimum acceptable gap time and number of pedestrians that cross. The total number of acceptable gaps during the study period is determined by dividing each recorded gap by the minimum acceptable gap time, discarding all fractions, and totaling the quotients.

Acceptable gaps per minute are determined by dividing the total number of acceptable gaps by the study period length in minutes. The crossing is considered to be acceptable for pedestrian use if there is at least one acceptable gap per minute.

VARIATIONS:

Gaps per phase study: This study is conducted at a signalized intersection approach crossing. Minimum acceptable gap time is computed the same as above, but gaps are only recorded during the pedestrian phase on the study approach. Whether or not at least one acceptable gap was available during each signal phase (along with pedestrians crossing) is recorded and proportion of phases with gaps over total phases studied is computed.

Left turn gap study: This study is conducted to determine if there is at least one acceptable gap per vehicle for left turns to cross either opposing through traffic or conflicting traffic in the case of left turns entering a major street from a side street. Minimum acceptable gap time for passenger cars on a level approach is defined as 7 seconds.

Example

GAP ANALYSIS

Location Reynolds St. and Champlain St.

Direction North leg By Dave Hrankovski

Time 8:30 - 9:02 Date 10/12/89 Day Thursday Weather 50-55° cloudy

Road Width 26' Xing Time 12 sec. Acceptable Gaps 107 Number Of Peds 4, N leg 27, S leg

NOTE: (ROAD WIDTH / WALKING SPEED + REACTION TIME (5 sec.) = XING TIME)
(VEHICLE CLEARANCE = 7SECONDS)
*children & Elderly - 3.5 sec., other - 4 sec. 3.57 gaps/min average

~~Cycle Length~~ ~~Ped Interval~~

Notes: * - crossed South leg ** - Crossed South leg - mid block

TIME	GAP	PEDS	TIME	GAP	PEDS	TIME	GAP	PEDS	TIME	GAP	PEDS	TIME	GAP	PEDS
8:30	21		"	33										
"	21		8:41	1:24	1*									
8:31	15		8:42	1:00	3*									
"	9		8:43	1:08										
"	20		8:50	1:19	4**									
8:33	41		8:51	48	1*									
8:33	41		8:52	34	2									
8:34	45			27										
"	20		8:53	19	1									
"	25			10										
8:35	10			10	1									
	46		8:54	16										
8:36	29			21										
	25		8:55	25										
8:37	58		8:56	37	6*									
8:38	22			42	4**									
8:39	50		8:57	19										
	32		8:58	16	2**									
8:41	1:21			17										
	25			20										
8:42	33	2*		25										
	34		9:00	29										
8:43	55													
8:44	16													
8:45	53	4*												

COMMENTS

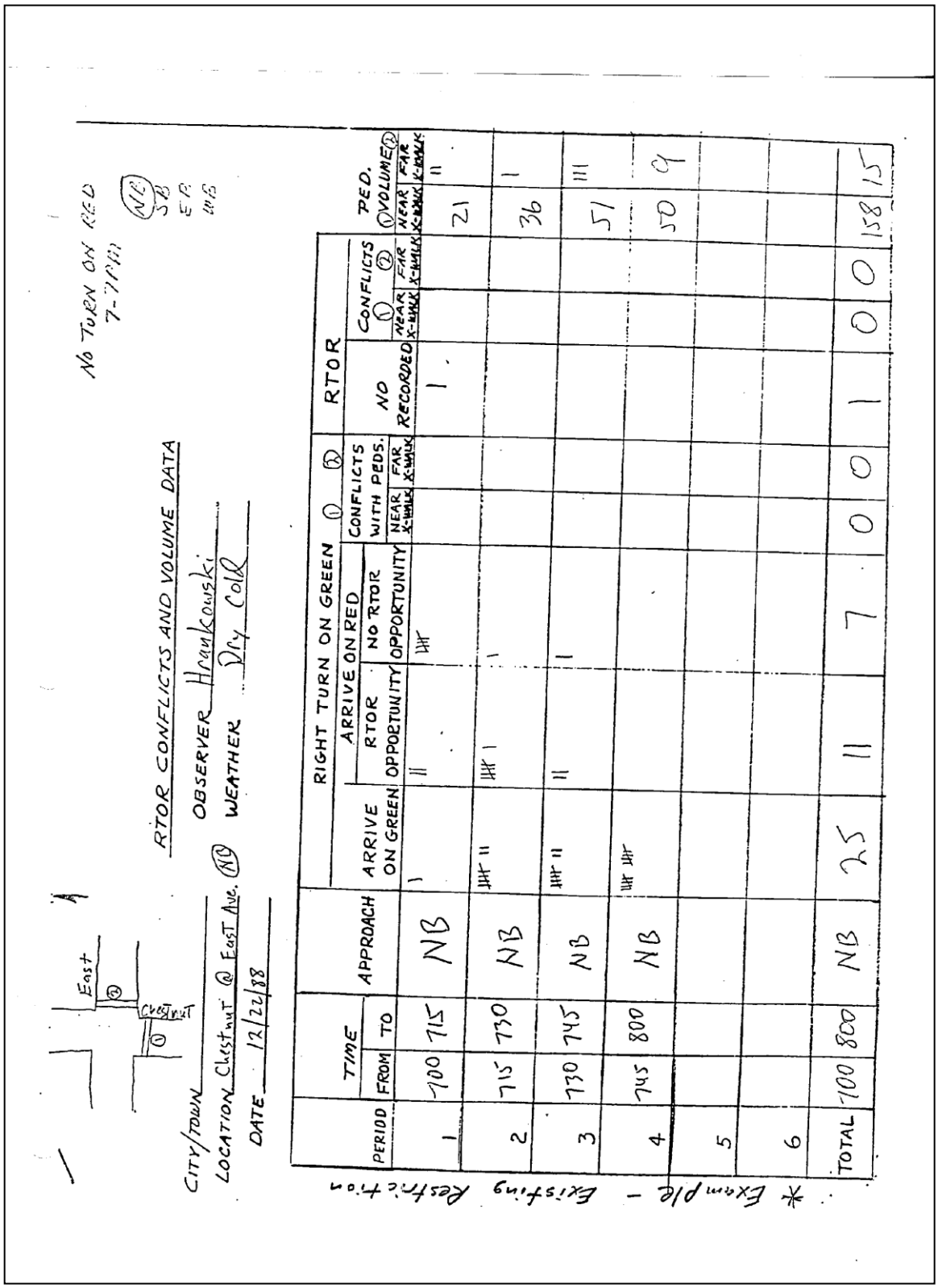
Gap Analysis Survey

APPENDIX F – RIGHT TURN ON RED SURVEY

To survey for either an existing or proposed "No Turn On Red" (NTOR), or just to survey a right turn on red movement, the following data is gathered.

- Right turns on red
- Right turns on green
- Opportunities to turn right on red (optional for an existing restriction)
- Conflicts with pedestrians and vehicles on the cross street
- Pedestrian volumes

The above methodology can also be applied to left turns on red.



RTOR CONFLICTS AND VOLUME DATA

CITY/TOWN _____ OBSERVER Hrankowski

LOCATION Chestnut @ East Ave. (NB) WEATHER Dry Cold

DATE 12/22/88

NO TURN ON RED 7-7PM

(NB) SB EB WB

East

Chestnut

PERIOD	TIME FROM	TIME TO	APPROACH	RIGHT TURN ON GREEN ① ARRIVE ON GREEN	RIGHT TURN ON GREEN ARRIVE ON RED RTOR OPPORTUNITY	RIGHT TURN ON GREEN ARRIVE ON RED NO RTOR OPPORTUNITY	RIGHT TURN ON GREEN ② CONFLICTS WITH PEDS. NEAR X-WALK	RIGHT TURN ON GREEN ② CONFLICTS WITH PEDS. FAR X-WALK	RTOR NO RECORDED	RTOR CONFLICTS ① NEAR X-WALK	RTOR CONFLICTS ② FAR X-WALK	PED. VOLUME ① NEAR X-WALK	PED. VOLUME ② FAR X-WALK
1	700	715	NB	1	11	1HT			1			21	11
2	715	730	NB	1HT 11	1HT 1	1						36	1
3	730	745	NB	1HT 11	11	1						51	111
4	745	800	NB	1HT 1HT								50	4
5													
6													
TOTAL	700	800	NB	25	11	7	0	0	1	0	0	158	15

* Example - Existing Restriction

Right Turn On Red Survey

APPENDIX G – SPOT SPEED SURVEY

When a speed study using automatic traffic counters is either not feasible or not necessary, we use radar equipment to sample the speeds of free flowing vehicles. Sampling 100 vehicles in each direction will get an adequate estimate of the speed statistics we usually use. The radar beam must be as parallel as possible to the approaching vehicles and the operator must be discrete to get the most accurate data. If use of radar is obvious, drivers will slow and skew the data.

Speed In MPH	Freq.	Total	Speed In MPH	Freq.	Total
11			41	1	114
12			42		
13			43	1	115
14			44		
15			45		
16			46		
17			47		
18			48		
19			49		
20			50		
21			51		
22	1	1	52		
23	111	4	53		
24	1	5	54		
25	1111	9	55		
26	1111 11	16	56		
27	11 1111 1111	28	57		
28	1111 1111 1111	42	58		
29	111 1111 1111	55	59		
30	1111 1111	63	60		
31	1111 11	70	61		
32	111 1111 1111	83	62		
33	1111	88	63		
34	1111 11	95	64		
35	1111 1111	104	65		
36	1111	108	66		
37	1111	112	67		
38	1	113	68		
39			69		
40			--		

TOWN: City of Rochester

LOCATION: Chili Ave (St Augustine school speed zone)

POSTED SPEED: 20 mph

OBSERVERS NAME: R. Gray

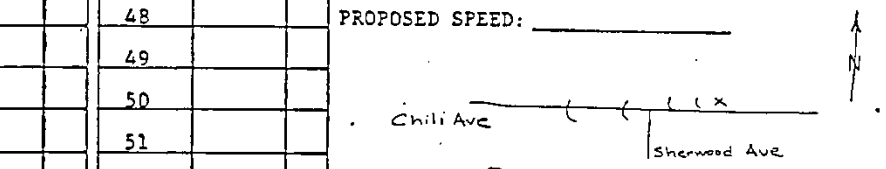
DIRECTION OF TRAVEL: EB

DATE: 9 Dec 85

TIME: FROM: 11:50 TO: 12:20

MEDIAN SPEED:

PROPOSED SPEED:



REMARKS: 85% speed = 35 mph

% over 20 mph = 100%

10-mile pace = 26-36 mph

% in pace = 86%

DIVISION OF TRAFFIC ENGINEERING

ANALYSIS SECTION

SPEED DATA SHEET

Spot Speed Study with Radar

APPENDIX H – VEHICULAR/PEDESTRIAN INTERSECTION TRAFFIC COUNT

Turning movement counts are manual counts done by one or more technicians in the field. Information that may be gathered in a turning movement count includes:

1. Vehicle volume according to direction of travel.

2. Turning movements at the intersection.

3. Pedestrian volume at crosswalks.

4. Peaking characteristics of traffic.

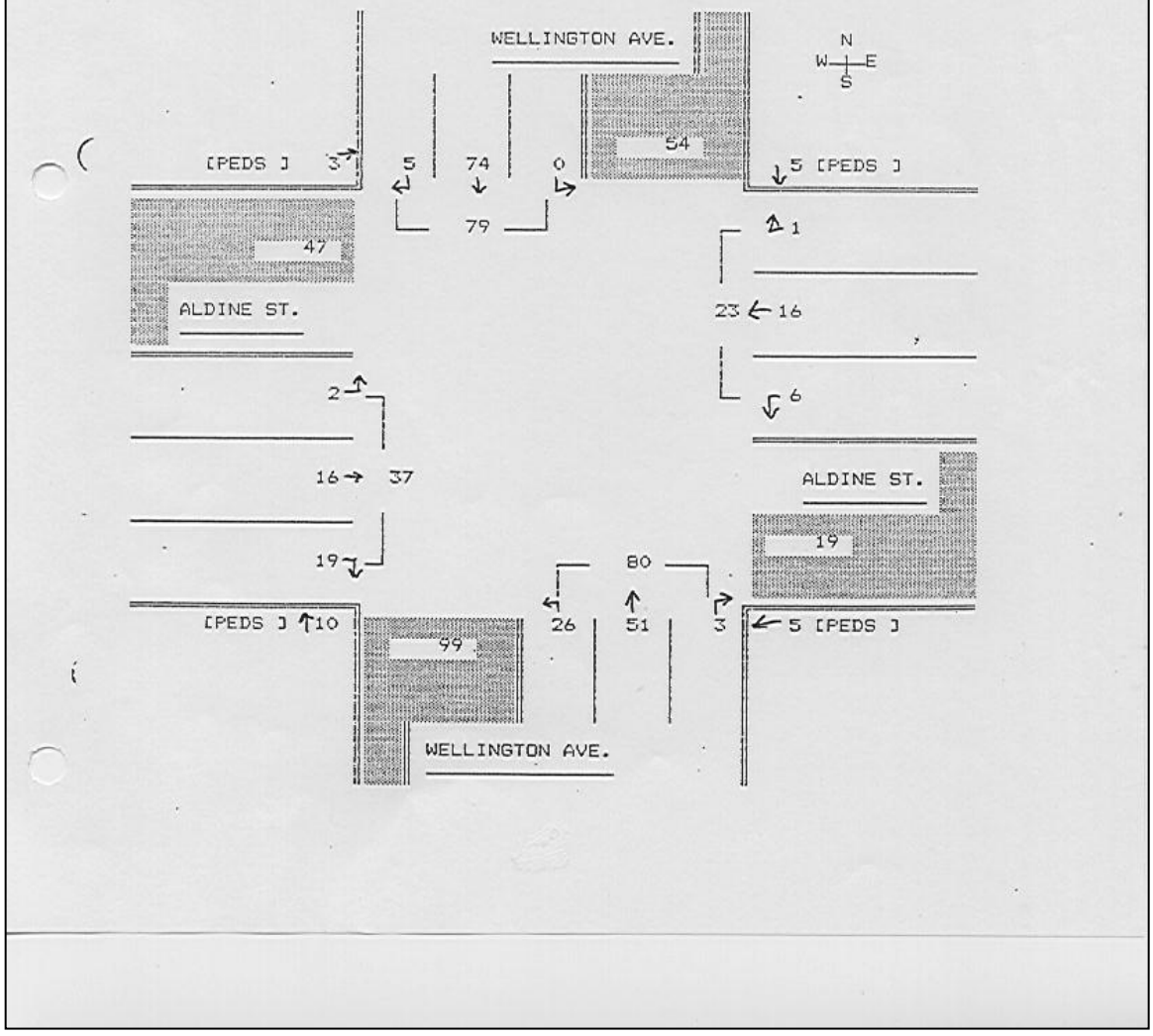
Electronic or mechanical counting boards are used to tally the vehicles according to direction of approach to and exit from the intersection during successive time intervals that are usually 15 minutes in length. The boards should be oriented with the north arrow pointing north to ensure proper recording of the data on the sheet.

MONROE COUNTY TRAFFIC ENGINEERING

Site Code : 10702 — PAGE: 1
E-S Street: WELLINGTON AVE. — FILE: 10702
N-W Street: ALDINE ST.
TOWN : CITY — Primary Movements: Vehicles — DATE: 10/05/89

PEAK PERIOD ANALYSIS FOR THE PERIOD: 7:00 AM - 09:00 AM

DIRECTION FROM	START PEAK HOUR	PEAK HR FACTOR	VOLUMES PEDS	Right	Thru	Left	Total	PERCENTS PEDS	Right	Thru	Left
North	7:30 AM	0.82	2	4	76	2	82	-	5	93	2
East	7:15 AM	0.72	5	2	14	10	26	-	8	54	38
South	7:00 AM	0.74	5	3	51	26	80	-	4	64	32
West	7:15 AM	0.70	5	19	17	3	39	-	49	44	8
Entire Intersection											
North	7:00 AM	0.90	3	5	74	0	79	-	6	94	0
East		0.64	5	1	16	6	23	-	4	70	26
South		0.74	5	3	51	26	80	-	4	64	32
West		0.66	10	19	16	2	37	-	51	43	5



Vehicular/Pedestrian Intersection Traffic Count

APPENDIX I – VEHICULAR DELAY SURVEY

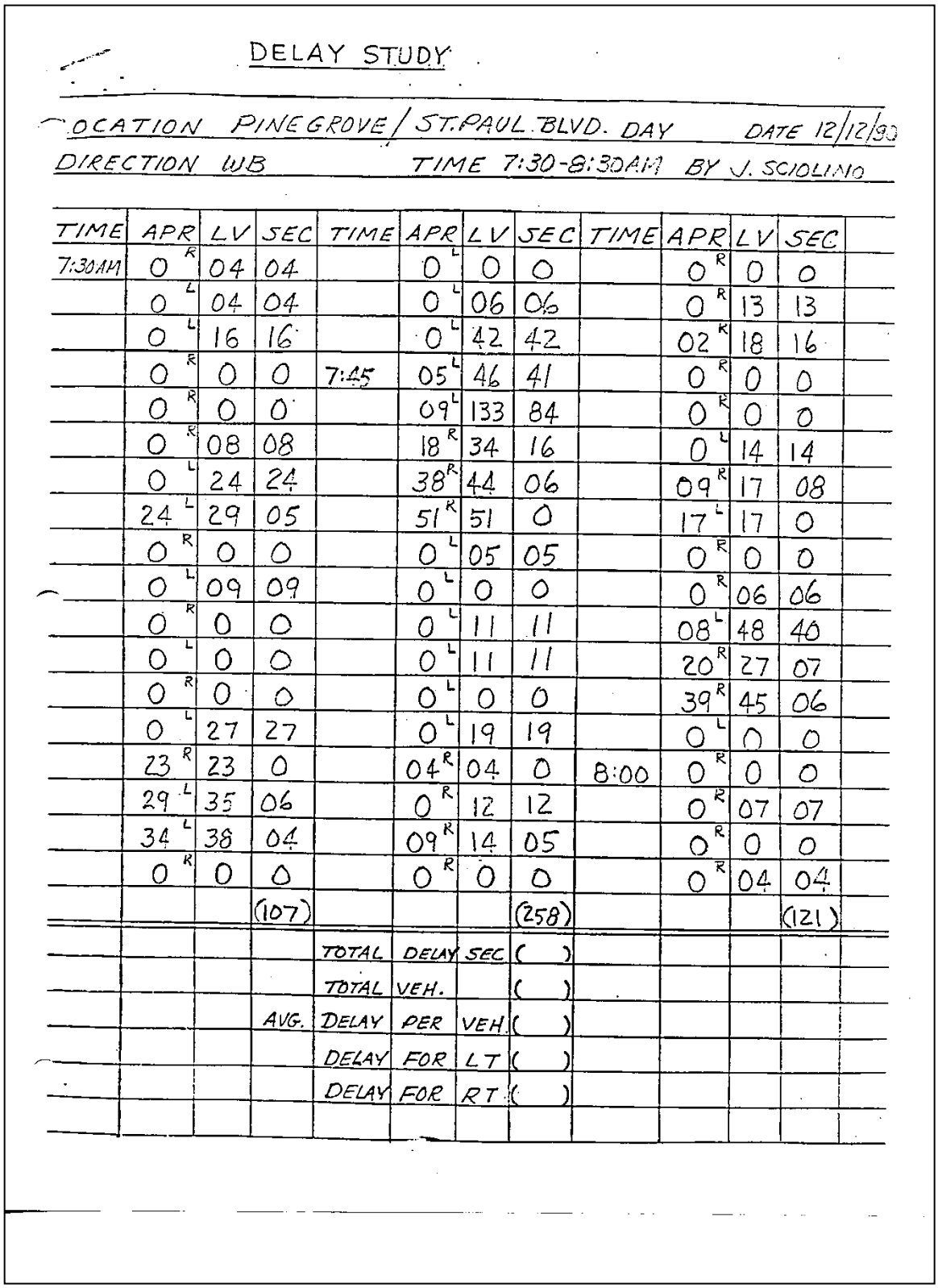
The performance of an intersection in allowing traffic to enter and pass through can be evaluated through intersection delay studies. An unusually long delay for vehicles on one or more approaches means that the intersection may not be performing in a satisfactory manner, indicating that corrective measures should be explored.

Our method of study is a manual method and requires one or more observers, a stop watch (preferably digital), and a delay study field sheet. One approach is studied at a time. The field sheet has spaces for time, arrival time of each vehicle, departure time of each vehicle, and number of seconds each vehicle is stopped.

When a vehicle arrives, start the watch at 0. As successive vehicles arrive, document the time on the watch under the "APR" column on the field sheet. At the same time document the time each vehicle leaves under the "LV" column and whether it was a RT, LT, or through move if studying more that one movement. When the queue clears, reset the watch to 0 until the next arrival.

Used for intersection delay studies are as follows:

1. Evaluation of efficiency of traffic control devices at intersections
2. Evaluating the need for additional signal phases
3. Determination of need for traffic signals
4. Examination of critical intersection geometrics
5. Analysis of improvements using before and after studies



DELAY STUDY

LOCATION PINEGROVE / ST. PAUL BLVD. DAY DATE 12/12/90

DIRECTION WB TIME 7:30-8:30AM BY J. SCIOLINO

TIME	APR	LV	SEC	TIME	APR	LV	SEC	TIME	APR	LV	SEC
7:30AM	0 R	04	04		0 L	0	0		0 R	0	0
	0 L	04	04		0 L	06	06		0 R	13	13
	0 L	16	16		0 L	42	42		02 R	18	16
	0 R	0	0	7:45	05 L	46	41		0 R	0	0
	0 R	0	0		09 L	133	84		0 R	0	0
	0 R	08	08		18 R	34	16		0 L	14	14
	0 L	24	24		38 R	44	06		09 R	17	08
	24 L	29	05		51 R	51	0		17 L	17	0
	0 R	0	0		0 L	05	05		0 R	0	0
	0 L	09	09		0 L	0	0		0 R	06	06
	0 R	0	0		0 L	11	11		08 L	48	40
	0 L	0	0		0 L	11	11		20 R	27	07
	0 R	0	0		0 L	0	0		39 R	45	06
	0 L	27	27		0 L	19	19		0 L	0	0
	23 R	23	0		04 R	04	0	8:00	0 R	0	0
	29 L	35	06		0 R	12	12		0 R	07	07
	34 L	38	04		09 R	14	05		0 R	0	0
	0 R	0	0		0 R	0	0		0 R	04	04
			(107)				(258)				(121)

TOTAL DELAY SEC ( )

TOTAL VEH. ( )

AVG. DELAY PER VEH ( )

DELAY FOR LT ( )

DELAY FOR RT ( )

Vehicle Delay Study – Page 1

DELAY STUDY

LOCATION PINEGROVE / ST. PAUL BLVD. DAY DATE 12/12/02

DIRECTION WB TIME 7:30-8:30 AM BY J. S.

TIME	APR	LV	SEC	TIME	APR	LV	SEC	TIME	APR	LV	SEC
	0 L	33	33	8:15	0 R	0	0				
	10 R	20	10		0 L	07	07				
	15 R	22	07		0 L	0	0				
	0 R	16	16		0 R	04	04				
	0 L	06	06		0 L	09	09				
	0 L	05	05		0 R	0	0				
	03 L	07	04		0 L	105	65				
	0 R	0	0		48 L	110	22				
	0 R	0	0		0 L	0	0				
	0 L	04	04		0 R	0	0				
	04 R	07	03		0 R	0	0				
	0 R	0	0		0 R	0	0				
	0 R	0	0		0 R	05	05				
	0 L	14	14		03 R	07	04				
	0 R	0	0		05 R	09	04				
	0 R	09	09								
	0 L	46	46								
	0 R	07	07								
			(164)				(120)				( )
				TOTAL DELAY SEC			(770)				
				TOTAL VEH.			(92)				
			AVG.	DELAY PER VEH			(8.3)				
				DELAY FOR LT			(15.5)	577/37			
				DELAY FOR RT			(3.5)	193/55			

Vehicle Delay Study – Page 2

APPENDIX J – VEHICULAR QUEUE SURVEY

At the start of the green phase, total the number of vehicles queued in each lane of the approach you are observing. You may have to combine some movements on your sheet, such as through and left or through and right.

TE 53 (4/69)

HIGHWAYS & TRAFFIC ENGINEERING
TRAFFIC ENGINEERING ANALYSIS SECTION
VEHICLE DELAY STUDY DATA SHEET

SHEET 1 OF 1
FILE

CITY ~~or VILLAGE~~ ROCHESTER | TOWN | COUNTY Monroe

DELAYS TO TRAFFIC ON STATE ST SB | ENTERING @ ANDREWS ST.

4-6PM Ø 100 | TURNING LEFT (THRU) RIGHT

TIME OF STUDY 4:30-5:30 | DATE 8/8/89 | WEATHER | OBSERVER J. SCIOLINO

VEHICLE	START	END	LENGTH OF QUEUE	REMARKS
1	4:30	Ø	4	
2		Ø	4	
3		Ø	1	
4		Ø	1	
5		Ø	2	
6		Ø	3	
7		Ø	3	
8		Ø	4	
9		Ø	1	
10	4:45	Ø	0	
11		Ø	9	2 single LT
12		Ø	4	
13		Ø	5	
14		Ø	9	
15		Ø	3	
16		Ø	3	
17		Ø	3	
18		Ø	2	
19				
20				
21				
—				
23				
24				
25			1	

VEHICLE	START	END	LENGTH OF QUEUE	REMARKS
26	5:00	Ø	8	
27		Ø	5	
28		Ø	5	
29		Ø	6	
30		Ø	8	
31		Ø	4	
32		Ø	13	Queing to the turn
33		Ø	6	
34		Ø	4	
35	5:15	Ø	2	
36		Ø	3	
37		Ø	3	
38		Ø	2	
39		Ø	11	
40		Ø	4	
41		Ø	2	
42		Ø	5	
43		Ø	2	
44				
45				
46				
47				
48				
49				
50				

Vehicular Queue Survey

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